NOTES

ON SOME

INDUSTRIES OF ASSAM

FROM

1884 to 1895.

Compiled in the Office of the Secretary to the Chief Commissioner of Assam, and Published by Authority.

SHILLONG:

PRINTED AT THE ASSAM SECRETARIAT PRINTING OFFICE.

1896.

Price Rs. 2—Inclusive of Postage.

SHILLONG :

PRINTED BY THE SUPERINTENDENT OF THE ASSAM
SECRETARIAT PRINTING OFFICE.

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SILK IN ASSAM.

By E. STACK, Esq., C.S., 1884.

I.—ASSAM AS A SOURCE OF SUPPLY TO THE ENGLISH MARKET.

Commercial worthlessness of the *wild* silkworms of Assam.

SOME misapprehension seems to prevail among English silk-spinners with regard to the nature of the silk-worms which furnish the silks of Assam. I find the domesticated *muga* and *eri* included in Mr. Wardle's pamphlet on the wild silks of India, while in a lecture on silk-spinning delivered in the Technical College, Glasgow, the tusser worm is alluded to as generally cultivated in this province. A similar misconception (so far as Assam is concerned) appears to pervade the Resolutions of the Government of India of the 23rd November 1875 and of the 28th February 1879, directing tusser to undomesticated silk-spinning worms in general and to the attention silkworm in particular, and asking for certain information regarding them. The information required will be found in the second part of this note ; but in treating of the silks of Assam it is desirable to make it clear at the outset that from the wild silkworms of Assam nothing whatever is to be expected. They may possess a scientific interest, but they are certainly destitute of all commercial value, present or prospective. Their cocoons in the wild state are not to be found in numbers anything like sufficient to repay the cost of collecting, or to furnish the slightest hope that they will ever be able to supply the English market. It is exceedingly doubtful whether by the most strenuous efforts one hundredweight of wild cocoons of all sorts could be collected in the whole of the Assam Valley. The commonest of all is the variety of tusser called *kutkuri* in Assam, and this is so rare that virtually one never hears

of it. In times previous to British rule, this worm used to be cultivated to a small extent in the vicinity of Jorhát, but it has long fallen out of fashion ; and in 1877 the Chief Commissioner of Assam (Colonel Keatinge) was of opinion that to attempt to create a tusser silk industry in this province would be simply to court failure. More recently, the failure of Major Coussmaker's operations in the Deccan has proved the futility of attempting to make anything out of tusser in Assam, where it is vastly less abundant. Such being the prospects of tusser, it is hardly necessary to speak of the other wild worms of Assam. Eight species are described hereafter, whereof three are the wild varieties of the *pat*, *muga*, and *eri* worms, and none of them are turned to any practical account, though cocoons found by chance in the jungle may occasionally be brought home by the cultivator and reeled or spun together with cocoons of his own brood. In the wild state they occur but sparingly, their principal habitat being the dense and unpeopled jungle of the submontane tracts, while the possibility of domesticating them need not be considered for a moment. It is not to be expected that the Assamese, who take so little care and trouble with the domesticated worms they have already, could ever be induced to make experiments with a new species, nor is there any reason to believe that the produce of the wild worms, even if successfully cultivated, would prove in any way superior to the existing silks of Assam.

The domesticated silk-worms of Assam.

2. Dismissing the wild worms, therefore, from consideration altogether, we have three kinds of domesticated worms in Assam, or rather, it may be said, in the Brahmaputra Valley, for the Surma Valley is not generally a country of silk cultivation. These are the *pat* or mulberry worm (*bombyx textor*); the *muga* or *sum*-feeding worm (*antheræa Assama*), whose cocoon, like that of the *pat*, can be reeled ; and the castor-oil worm (*attacus ricini*), yielding a silk which is never reeled, but spun by hand. Looking simply to their commercial potentialities, these three species of silkworm may at once be reduced to two, by striking off the mulberry worm (*pat*), on account alike of the costliness of its silk, the scantiness of the present supply, and the difficulty of extending its cultivation. The two remaining species, the *muga* and *eri*, present a much more hopeful field of enterprise. They are produced in considerable quantity already ; they are thoroughly adapted to the climatic conditions of Assam (being, indeed, probably indigenous to this part of India), and there is no obvious reason why their cultivation should not be capable of immense development. The *eri* is the more promising of the two, both because it is cheaper and more abundant, and also

because, being reared entirely indoors, its cultivation does not entail that troublesome necessity of watching by night and day which is imposed upon the *muga*-breeder during the period that his worms are on the trees. The *muga*, indeed, yields the finer silk, but as it is only in the roughest shape that Assam silk can hope to become an article of demand in the English market, the difference of quality will perhaps prove to be a matter of secondary importance.

Form of silk trade possible between Assam and England.

3. There are two forms in which a silk trade is conceivable between Assam and England. We may export the thread, or we may export the cocoons. It may be said at once that the export of thread would never pay. *Muga* thread is now selling at about Rs. 8 and *eri* at about Rs. 5 the seer (6*s*. 8*d*. and 4*s*. 2*d*. the pound) ; and when it is remembered that the reeling is of the rudest character possible, that the thread is coarse and uneven, and that no two skeins, as a rule, will be found to correspond in quality, it will easily be understood why *muga* is incapable of competing with the finer and not more expensive silks of Bengal ; and, indeed, in Bengal itself the silk-reeling business has for some time been in a stationary or decaying condition. *Eri* thread is still more "uneven, gouty, and knibby," and would probably be regarded by the English manufacturer as unfit for employment for any purpose. From the export of cocoons, on the other hand, there may possibly be something to hope. The manufacture of silk plushes and similar fabrics out of waste cocoons imported from India or China is a flourishing branch of the silk industry in England, and although China has hitherto been the principal source of supply, there is no reason why Assam should not contribute large quantities of an article which is produced with so much ease in the valley of the Brahmaputra. The kind of thing that is wanted is described in the following words by one of the English gentlemen engaged in its manufacture :

> The class of silk called *spun* silk is made by a combing and carding process out of the refuse of *thrown* silk, and out of cocoons that are damaged and not windable, and out of *pierced* cocoons, as we name those from which the moth in the order of nature has escaped. It is in this latter condition that I think wild* silks should be found somewhere in India, and this is what I principally want. I do not wish to wind such silk, but to *spin* it into fine thread. It is no matter how broken and rough it may look, or how much it is knocked about, torn, or crushed. I only want it as free as possible from the dead bodies of the worms, and of such foreign matters as sand or branches. It will not look like silk at all, till the

* It has already been noted that *wild* silk, properly so called, can never become an article of commerce in Assam.

gum and dirt are boiled and washed out of it. You observe I ask nothing from India that requires skilled labour or machinery; only to collect the raw material in a state in which it must be almost valueless in India,* and let us by our superior mechanical appliances make something of it here. * * * *Eri* I like best for its whiteness. I believe it breeds frequently, but I do not believe any amount of cultivation could get *thrown* silk out of it. I mean of course, to be of any commercial value. * * * *Muga* is darker than *eri*, but has some other properties that are valuable, principally as a *spun* silk. * * * No *eri* or *muga* waste cocoons have, as far as I know, ever been sold in the London market. I only know trifling samples having been tried too small to base any value upon. * * * *Tusser* waste silk, however, is regularly sold in London. It comes both from India and China; the price is about 1*s.* 6*d.* the pound, and it is very dirty. I should say the *eri* and *muga* would be much more valuable.

In a letter from another firm engaged in the same business, I find the raw material described as "pierced or spoilt cocoons—cocoons from which the moth has worked itself out and escaped," while cocoons with the chrysalis inside them are not wanted at all.

Now, in comparison with other parts of India, Assam seems to possess superior capabilities for supplying a demand of this nature. The conditions of tusser cultivation in Bengal, as described by the Commissioner of Chota Nagpur (Supplement to *Calcutta Gazette* of 31st October 1883) appear much less favourable than the conditions of *muga* cultivation in this province. He calculates that a man can tend 15 trees, yielding 450 cocoons in an ordinary year and 1,500 in a bumper year, such as occurs occasionally; and the selling price of the cocoons is 160 the rupee. The *muga* cultivator in Assam would obtain more than 3,000 cocoons from an equal number of full-grown *sum*-trees, and the price of the whole cocoons is about 600 the rupee. It follows that Assam ought to be in a much better position to supply cocoons to the English silk-spinner than the principal tusser-producing districts of Bengal. If a similar calculation be made with regard to *eri* cocoons, the result appears still more favourable.

Previous attempts to develop silk cultivation.

4. No attempt seems ever to have been made to develop the cultivation of *muga* for the English market, but we have the record of Mr. C. H. Lepper's experiment with *eri* in the Lakhimpur district about 1872-73. Mr. Lepper was commissioned by Messrs. Lister & Co. to take up land and try the experiment of rearing the *eri* worm on a large scale, so as to thoroughly prove the practicability of procuring silk in sufficient quantity to make the business pay. His choice of a site in the southern portion of Lakhimpur was

* It is not valueless, having its use and its price among the natives of India.

perhaps an unfortunate one, as the worm is much more widely cultivated on the confines of Kámrúp and Darrang. He found the climatic conditions exceptionally favourable, the supply of food abundant, and the worm so peculiarly adapted to breeding as to suggest the belief that with proper care a constant rotation of crops could be obtained, so that the operations of breeding and spinning might go on uninterruptedly all the year round. Some experiments made with the cocoons also pointed to the possibility of considerably improving them in size and quality. But the difficulty of procuring labour, and its costliness when procured (local labour being quite inefficient), were so great as to deter him from advising Messrs. Lister & Co. to continue operations. His own estimate was that the cost of suitable buildings, on even a moderate scale, to replace the native style of house, which is not proof against damp, rats, or insects, would not be less than £3,000. A similar attempt was made some six years ago by a European in the neighbourhood of Rangia, in Kámrúp, but he was compelled to abandon it after losing his entire crop by disease.

Experiments now being made.

5. In the face of these precedents the prospect of *eri* cultivation on a large scale, either by the Government or by private enterprise, is not encouraging, and the difficulties are still greater in respect of *muga*. But the case is different with the native breeder, who spends nothing, and, therefore, can suffer no loss. Were a market once opened for *muga* and *eri* cocoons at fixed rates and in unlimited quantity, it is probable enough that the cultivators would be glad to bring their cocoons to it, and that, under the stimulus of a regular and certain demand, the supply would soon begin to increase. Only the waste cocoons—the perforated cocoons through which the moth has been allowed to eat its way—would be required, and the seller would not even be put to the trouble of boiling his cocoons as he does now before offering them for sale. The practicability of getting up a supply for the English silk-spinner in this way depends, of course, upon the price which he finds it worth his while to offer for the article supplied. Some light ought to be thrown upon this question by the reports of certain English firms upon the samples of *muga* and *eri* despatched to them from Gauháti last November. The whole quantity was 41 lbs. of whole *muga* cocoons and 246 lbs. of waste *eri* cocoons. The former costs Rs. 17-14-0 at the place of sale, the latter Rs. 71-14-0. Taking the rupee at 1*s.* 8*d.*, these prices represent a rate of 9¾*d.* and 6½*d.* per lb. respectively, The rate of 9¾*d.* per pound for *whole* cocoons of the *muga* species (450 to the pound) is doubtless a prohibitive one, but it is believed that *waste* cocoons sell at about the same price, weight for weight,

and in that case it would probably be worth while to export them to England if the price ruling there were 1*s.* 3*d.* per pound. The waste *eri* cocoons are so cheap as to leave a much larger margin of profit, but their value in the English market may prove to be comparatively low. The matter, however, has now been brought to the test of experiment, and if these prices prove capable of attracting English silk-spinners, there will probably be no difficulty in obtaining a much larger supply next year, simply by proclaiming that the Government is prepared to buy all cocoons offered for sale at these rates in stated markets of the chief silk-producing tracts. Even as it is, the demand for waste silk in England has already begun to attract a trade in *eri* cocoons, and some 400 to 500 cwt. are exported annually from Goalpara to Calcutta for shipment to London. This supply, however, is very far from representing the full productive capability of the Assam Valley.

II.—DESCRIPTION OF THE VARIETIES OF SILKWORMS FOUND IN ASSAM.

A.—DOMESTICATED SILKWORMS.

I. THE ERI WORM AND SILK.

Nature of the worm.

6. The *eri* worm (*attacus ricini*) derives both its scientific and its vulgar name from its attachment to the castor-oil plant (*ricinus communis*), called *eri* in Assamese. It feeds also on the *keseru* (*heteropanax fragrans*), and there are several other trees, as the *gulancha* (*Jatropha curcas*), the *gamri* (*Gmelina arborea*), and even, it is said, the common *bogri* or *ber* tree (*zizyphus jujuba*), which the worm can thrive on in its later stages, if other food is not procurable in sufficient quantity. The *eri* worm is a multivoltine and is reared entirely indoors. The castor-oil plant grows abundantly in the raiyat's garden, springing up from dropped seed in every little patch of unoccupied land around his house. The tending of the worms devolves principally upon the women of the family, and goes on all the year round. As many as eight broods can be obtained in twelve months, but the number actually reared never exceeds five or six, and depends a good deal upon the quantity of food which chance has provided for the worms, since no care is taken to ensure a supply by planting out trees. It is the

autumn, winter, and spring broods, spinning their cocoons in November, February, and May, respectively, which are chiefly destined for use, and of these the spring cocoons are the most numerous, and yield the most silk. The broods of the rainy months—June to September—are reared for the purpose of perpetuating the stock. But both breeding and spinning, to a greater or less extent, go on all the year round.

Treatment of cocoons for breeding.

7. Cocoons reserved for breeding are placed in a round basket woven of bamboo, with a narrow mouth, and are hung up in the house out of the way of rats and insects. After about 15 days in the hot season, and 20 to 30 days in the colder months, the moths emerge, and are allowed to move about in the basket for four-and-twenty hours. The females, distinguished by their larger body and broader and flatter abdomen, are then tied to pieces of reed or *ulu* grass by a ligature passing under the shoulder-joint of a pair of wings on one side of the body only, leaving the pair of wings on the other side free. Ten moths will thus be tied to a piece of reed two feet long. The males, though left at liberty, do not attempt to fly away, but remain with the females to which they have attached themselves until the latter have laid their eggs, when the males depart. If some of the females, as may easily happen for want of any criterion of sex in the cocoon, are unprovided with males, they are exposed on the eaves of the house in the evening, and are visited by any stray males that may be in the vicinity. The female lays about 200 eggs in three days, and the life of the moth lasts a day or two longer.

Hatching and nurture.

8. The eggs are picked off the straws, wrapped in a piece of cloth, and hung up in the house. The period of hatching varies with the season: in the month of May, with an average temperature of 83°F., it has been found not to exceed a week, but in the winter it is about 15 days, and in the months of medium temperature 9 or 10 days is the usual term. When the eggs begin to hatch, the cloth is opened, and tender leaves of the castor-plant, previously crushed between the fingers to render them still softer, are supplied to the young worms for food, and subsequently they are transferred to a bamboo tray suspended in a place of safety. As the worms grow stronger, older leaves are given to them. Their supply of food is occasionally intercepted by swarms of caterpillars appearing on the castor-oil plant about the month of June. These must be carefully removed from the leaves that are given to the silkworms, and the leaves themselves washed in water. It is at seasons like this that the leaves of a variety of trees are used as substitutes for the favourite food of the worm.

Diseases and enemies.

9. Large numbers of the worms are lost by disease, of which neither the nature nor the remedy is known, but which probably has its origin in uncleanliness. No care is taken to remove the excreta, nor are the dead worms regularly rejected. The native account of the disease is simply that the worm ceases to eat and withers away. Some good effects are said occasionally to follow from sprinkling water in which *tulsi* leaves have been steeped over the worms among which this disease has made its appearance. The ichneumon fly is a deadly enemy. Its bite, which leaves a black mark, usually proves fatal to the worm at the next moulting; and if the wound has been inflicted after the last moulting, the worm spins a smaller cocoon and dies before it is completed, leaving the eggs of the fly to hatch inside the cocoon. Rats are still more destructive, sometimes sweeping off an entire brood in a single night. The cultivator is careful to abstain from praising his crop of worms, lest any of these calamities should overtake them.

Life of the worm.

10. The number of moultings is four, known locally as *hâludia*, *duirkâta*, *tinirkâta*, and *châirikâta*; the first term denotes the yellow colour of the worm, the three others merely mark the order of the moultings. Mr. Thomas Hugon, who held the office of Sub-Assistant (corresponding to the present office of Assistant Commissioner) in the Nowgong district, contributed a very carefully written paper upon the silkworms of Assam to the Proceedings of the Asiatic Society of Bengal for 1837, whence the following description of the *eri* worm is taken: "The caterpillar is first about a quarter of an inch in length, and appears nearly black." (The colour is, perhaps, more exactly described as a blackish yellow.) "As it increases in size, it becomes of an orange colour, with six black spots on each of the twelve rings which form its body. The head, claws, and holders are black; after the second moulting, they change to an orange colour, that of the body gradually becomes lighter, in some approaching to white, in others to green, and the black spots gradually become the colour of the body. After the fourth or last moulting, the colour is a dirty white or a dark green. On attaining its full size, the worm is about 3½ inches long." According to one series of observations, it would appear that in the hot months the first change of skin occurs three days after hatching, and the rest follow at intervals of three days, while the worm begins to spin on the fourth day after the final change, or the 15th day after hatching. In the cooler months, the period before each moulting is four or five days, making 20 to 25 days between hatching and beginning to spin; and in the winter season the worm lives a whole month, or even longer.

After the final moulting, the worms are transferred from the tray, to forked twigs of the castor-oil plant, with the leaves on, suspended across a piece of reed. As the worms attain maturity they cease to feed, and crawl to the top of the fork; and if held up to the ear, and gently rolled between the fingers, their bodies emit a crackling or rustling sound. They are now placed on the *jáli*, which consists of a bundle of dried plantain leaves, or of branches of trees with the withered leaves attached, and this also, like the feeding-tray, is suspended from the roof within doors. Here they begin to spin, usually on the same day, and not unfrequently two worms will select the same leaves as their covert, and join their cocoons together. The time occupied in spinning is three to six days.

Duration of cycle.

11. It will be gathered from the foregoing that a complete cycle of the insect may be as long as twelve weeks in winter, or as short as six weeks in summer, while in the intermediate months it varies between these extremes. The maximum and minimum periods are shown in the subjoined table:

	Minimum days.	Maximum days.
Hatching	7	15
As a worm	15	32
Spinning cocoon	3	6
In the cocoon	15	30
As a moth (up to laying of eggs) ...	3	3
Total	43	86

The cocoons.

12. The dimensions of a full-sized cocoon are about $1\frac{1}{5}$ inch in length by $\frac{3}{4}$ inch in diameter. The cocoon without the chrysalis weighs five grains. It is destitute of floss. Its proper colour is white, but a large proportion of the cocoons are of a dark brick-red colour, for which it is difficult to account. Mr. Hugon, after noting that the colour of the mature worm is either dirty white or dark green, adds—"The white caterpillars invariably spin red silk, the green ones white." However this may be, it is at least certain that worms of the same brood, fed on the same leaves, will produce dark and light cocoons indifferently. The dark colour can be purged away by boiling the cocoon in alkali water. It is said that in some places where cocoons are sold the white cocoons are sorted out, and command a higher price. There seems to be reason to believe that, with proper care in providing the worms with suitable shelter for spinning, the proportion of white cocoons could be increased, and the quality also of the silk could be improved. Mr. C. H. Lepper, who in 1872 attempted the experimental cultivation of the *eri* worm in the

Lakhimpur district on a considerable scale, found that darkness in the place of spinning was a favourable condition. Some cocoons spun in a wine-case nearly filled with loose shreds of newspaper, and with the lid closed, proved to be perfectly white and exceptionally good.

Mode of spinning.

13. In preparing the cocoons for use, the first step is to destroy the life in the chrysalis. For this purpose exposure to the sun during one or two days is usually sufficient, and this is the method preferred by the cultivators, as enabling them to keep the cocoons longer, and avoiding the discolouration which is caused by fire. When fire has to be employed, it is applied under bamboo trays upon which the cocoons are placed. Cocoons intended for immediate use are boiled for two or three hours in an alkaline solution of the ashes of the plantain stem in water, which serves the double purpose of killing the chrysalis and softening the cocoon. Usually, however, the cultivator keeps his cocoons until he has a stock sufficiently large to make it worth his while to begin to spin. He then boils them in the solution described above ; or the ashes used may be those of grass, rice-straw, or the stems and leaves of the castor-oil tree, or of various other plants. In this way cocoons several years old, if they have been kept uninjured, can be softened and rendered capable of spinning. After this process, the cocoons are opened, and the chrysalis is extracted ; they are next washed white, slightly kneaded in the hand, dried in the sun, and are then ready for use. The *eri* cocoon has been successfully *reeled* in Italy, and experiments have shown that it can be reeled in India, but the only method employed by the cultivator is that of spinning off the silk by hand. At the time of spinning, the empty cocoons are placed in an earthen bowl containing water, with which a little cowdung is sometimes mixed. Each cocoon is taken up separately, and the silk is drawn off in a coarse thread, nearly as thick as twine. Uniformity of thickness is roughly preserved by rubbing the thread between the finger and thumb, and in this way also new cocoons are joined on. It is said that six spinners can spin about 4 chitaks (8 ozs.) of thread in a day, consuming thereby some 1,200 to 1,500 cocoons. A seer (2 lbs.) of empty cocoons will yield about three-quarters of a seer of thread.

Value of the cocoons, thread, and cloth.

14. Cocoons prepared in the manner above described are sold at Rs. 2½ to Rs. 3 per seer of about 3,600 cocoons, but the waste cocoons out of which the moth has been allowed to make its way (*khola* cocoons) can be had at about one-fourth of this rate. Pierced

eri cocoons sell in Calcutta at Rs. 60 to Rs. 70 the maund (82 lbs.). Cocoons containing the desiccated chrysalis sell at the rate of 1,200 to 1,500 the rupee, or about 9 annas per seer of 700 cocoons. These prices, however, are liable to great fluctuations, and it must not be supposed that there is anything like a fixed rate for cocoons. They are nowhere offered for sale in open bazar; and whether they can be procured in the villages or not depends very much upon the character of the season. If the brood has been a plentiful one, the superfluous cocoons are for disposal; if not, the cultivator will not part with those which he has reserved for his own use. The value of the thread varies from Rs. 4 to Rs. 7 per seer, and the most important fabrics woven from it are waist-cloths (*dhoti*) and sheets (*bor kapor*). The latter are large pieces of cloth about 6 to 7 yards long by 4 to 4½ feet in width, and their price varies from Rs. 7 to Rs. 20, according to quality. The cloth is often extremely coarse, and of a dark colour and open texture, but it is always very durable, and the texture grows closer by wearing, as the nap or floss rubbed off the thread serves to fill the interstices. A superior piece of *eri* cloth, on the other hand, is nearly as white as linen, and fine enough to make a travelling dress for a lady. One excellent quality of these fabrics is their exceeding durability, an ordinary *bor kapor* is reckoned to last thirty years.

Extent of cultivation.

15. The *eri* worm is cultivated to a greater or less extent in every district of the province. Being regarded as of doubtful purity, it is left principally to Rabhas, Meches, Kacharis, Mikirs, Kukis, and other non-Hindu tribes. In the submontane country inhabited by the Kacharis and their cognates, along the north of the districts of Goálpára, Kámrúp, Darrang, and Lakhimpur, almost every house has its patch of castor-oil plant, on which *eri* worms are fed. In some parts of this region the Marwari traders make advances to the cultivators in October, when the revenue is falling due, and take repayment afterwards in thread or cloth, and both these products are commonly exposed for sale in the petty markets in the same manner as other articles of village merchandise. A good deal of *èri* is also produced in the district of Sibságar, and in Upper Assam generally the raiyat may be seen swathed in a warm sheet of coarse *eri* cloth in the winter mornings and evenings. Throughout the whole range of the southern hills, from the Mikir country to the Gáro, *eri* thread is in great request for weaving those striped cloths in which the mountaineers delight. An estimate of 183 cwt. (250 maunds) has been furnished for the outturn of the North Cachar section of these hills, and a similar amount for the Khási Hills district. The Mikirs,

Kukis, and Gáros cultivate the worm for themselves, but the handsome and durable cloths worn by the Khásis and Syntengs are woven of thread procured from Mikir and Kuki breeders inhabiting the lower hills on the northern and southern faces of the range. All these people eat the chrysalis with avidity, considering it especially delicious in the form of curry. *Eri* is but little cultivated in the plains of Sylhet and Cachar.

Outturn of silk.

16. In the absence of any large markets, and indeed of any regular trade in either the thread or the cloth, it would be quite useless to attempt to conjecture the probable outturn of *eri* silk in Assam. An estimate of 25½ cwt. (35 maunds) has been furnished for the produce of Kámrúp, 177 cwt. (242 maunds) for Darrang, and 205 cwt. (280 maunds) for Nowgong, but the latter district probably produces less *eri* than either of the other two, and the estimate may be regarded as mere guesswork. In no district does the produce do much more than supply local wants. A trade in cocoons, to the extent of 400 or 500 cwt. yearly, has sprung up between Goálpára and Calcutta, whence the cocoons are shipped for England. They are said to come chiefly from Upper Assam. The cloth which finds its way to the shops of the Marwari traders is by them exported to Bengal. The mountaineers of Bhutan who visit the plains in the winter carry away with them a considerable quantity both of cloth and yarn. The quantity of cloth is estimated at 2,000 pieces, while the yarn is dyed by the Bhutias and woven into gaily-coloured coats and striped cloth, some of which find their way back to the bazars of Assam. The value of the silk thus exported from the three Bhutia fairs in the Darrang district last year was returned as Rs. 43,000, and probably we may allow as much more for the Bhutia trade in Kámrúp. As regards its use in the province, however, the general opinion is that the native *eri* is being supplanted by cotton goods from England. It is alleged that the cloth is procurable with more difficulty now than formerly, and it is certain that the price has risen greatly within the last thirty years. If we go back so far as fifty years, we find the yarn selling for two rupees a seer in 1834. There is, however, reason to doubt whether *eri* was more easily procurable then than it is now, and perhaps the rise of price is chiefly to be explained by the influx of money which has accompanied the development of tea cultivation. It is impossible to say whether the actual outturn is less or greater now than at any former period. There is no natural obstacle to an increase of production to any imaginable limit.

II. THE MUGA WORM AND SILK.

Nature of the worm.

17. The scientific name of the *muga* silkworm (*antheræa Assamœa*) denotes its peculiar connection with Assam, and in fact it is found in no other part of India except Dehra Dun, where it occurs sparingly. Its Assamese name is said to be derived from the amber colour of the silk, and is frequently used to denote silk in general, so that *eri muga* means *eri* silk, *kutkuri muga*, tusser silk, and so on ; the genuine *muga* being distinguished by the title of *sompatia muga*, or silk yielded by the worm that feeds on the *sum*-leaf. It is a multivoltine worm, and is commonly said to be semi-domesticated, because it is reared upon trees in the open air ; but in fact it is as much domesticated as any other species, being hatched indoors, and spinning its cocoon indoors, while during its life on the tree it is entirely dependent on the cultivator for protection from its numerous enemies. The *sum* tree (*machilus odoratissima*) furnishes its favourite food ; but in Lower Assam it is extensively bred on the *suálu* (*tetranthera monopetala*). The leaves of certain other forest trees—the *dighlati* (*tet. glauca*) the *pátichanda* (*cinn. obtusifolium*), and the *bamroti* (*symplocos grandiflora*)—can be eaten by the worm in its maturer stages if the supply of its staple food begins to fail ; but *sum* and the *suálu* are the only trees upon which the worm yielding the ordinary *muga* silk (as distinguished from *champa* and *mezankuri*, which will be mentioned hereafter) can be permanently reared. The *sum*-fed worm is considered to yield the more delicate silk, and *suálu* trees on the edges of *sum* plantations are generally left untouched, though small plantations of *suálu* only may occasionally be met with.

Number of broods in a year.

18. Five successive broods are distinguished by vernacular names roughly denoting the months in which the worms are bred and spin their cocoons. These are the *kátia* brood, in October—November ; *járua* in the coldest months, December—February ; the *jethua* in the spring ; the *aharua* in June—July ; and the *bhádia* in August—September. But it is only in few parts of the Assam Valley that this regular succession of broods is maintained. The *aharua* and *bhadia* broods are reared chiefly in the district of Kámrúp, whence cocoons are exported for the *kátia* brood in Upper Assam. In Darrang and Sibságar the only broods for use are the *kátia*, *járua*, and *jethua* ; while in Lakhimpur only the *járua* and *jethua* are generally in fashion. The worm is said to degenerate if bred all the year round in Upper Assam ; and another reason for the discontinuance of breeding in the summer is that the *sum* forests are flooded by the rains, the watching of the worms becomes more troublesome,

and losses increase. Hence the breeders of Upper Assam generally go down to Kámrúp or Nowgong to buy cocoons at the beginning of the cold season. Occasionally, a *bhádia* brood of inferior quality is reared in Sibságar on a highlying patch of *sum* land. Even in Jorhát, the centre of the cultivation of the *muga* silk-worm, one-fourth of the breeding cocoons, it is estimated, are imported from Kámrúp. The price of cocoons thus purchased varies from two to four rupees the thousand, according to the supply. Sometimes the worms themselves are sold at the rate of 100 to 150 per rupee.

Treatment of cocoons for breeding.

19. The cocoons intended for breeding are placed in trays of woven bamboo, and hung up safely within the house. The period of the chrysalis lasts about a fortnight in the warm months, and three weeks or a few days longer in the cold season, when the room in which the cocoons are kept has to be warmed by a fire, and they are sometimes suspended near the hearth.

If the cocoons are kept in a covered basket, the moths are allowed to move about inside it till the day following their emergence; but where open trays are employed, the female moths, recognisable at once by their bulkier body, are immediately tied by a thread passing round the thorax behind the wings to single pieces of straw, which are hooked on a line stretched across the room; or several moths may be fastened in this way to a bunch of straws 18 inches long by one in diameter. Straws black with smoke are usually selected, from a notion that the colour helps to reconcile the moth to captivity. The male moths are left free, and some of them make their escape into the open air, but the majority remain attached to the females. Any deficiency in the number of males is supplied by placing the females outside the house in the evening, when unattached males will discover and consort with them. A song chanted by the cultivator is supposed to attract the males on such occasions. Each female produces about 250 eggs in three days, and the life of the moth lasts one or two days longer, but eggs laid after the first three days are rejected, as likely to give birth to feeble worms.

Growth of the worms.

20. The pieces of straw, with the eggs deposited on them, are carefully taken down and placed in a basket covered with a piece of cloth. The room in which they are kept is heated by a fire in winter, or the eggs may be laid in a place warmed by the sun, but not directly exposed to his rays, the heat of which would prove destructive. They ought to be kept in the dark as much as possible. The period of hatching lasts from seven to ten days, according to the time of year.

In the summer months, it is not necessary to keep the eggs indoors at all, and they can be placed on the tree at once, with due precautions, however, against sun, rain, and dew ; and even in the winter a small proportion of the eggs may be placed out unhatched, together with the young worms. Generally, however, the worms are hatched indoors. " On being hatched " (says Mr. Hugon) " the worm is about a quarter of an inch long ; it appears composed of alternate black and yellow rings. As it increases in size, the former are distinguished as six black moles, in regular lines, on each of the twelve rings which form its body. The colours gradually alter as it progresses, that of the body becoming lighter, the moles sky blue, then red with a bright gold-coloured ring round each." The worm passes through four moultings, known respectively as *chaiura*, *duikâta*, *tinikâta*, and *maiki châl-kâta*. The full-grown worm, when extended in the act of progression, measures about 5 inches long, and is nearly as thick as the forefinger. Its colour is green, the under part being of a darker shade, while the back is light green, with a curious opaline or transparent tinge. Excluding the head and tail, the body is composed of ten rings, each having four hairy red moles, with bright gold bases, symmetrically disposed round its edge ; a brown and yellow stripe extends midway down each side from the tail to within two rings of the head, and below it the breathing holes are marked by a series of seven black points ; the head and claws are light brown, the holders dark green, with black prickles, the tail part widening above into green circles enclosing a large black spot Two sizes of the full-grown worm are distinguished. The *borbhogia* is 5 inches long, the *horubhogia* somewhat shorter ; and a similar difference is observed in the size of the cocoons. It is not necessary that the worms should complete their growth on a single tree. If the leaves be exhausted, they descend the trunk till they are stopped by a coil of straw rope, or by a band of plantain-leaves, which serves to arrest them till they can be gathered and transferred to another tree. This may be done either by simply placing them on the trunk and leaving them to crawl up (and if so treated, it is said they will refuse to ascend a tree which has already been stripped of its leaves), or by means of a triangular tray, which is pushed up at the end of a long bamboo, and hooked on to one of the upper branches. The latter is also the method employed in putting the young worms on the tree for the first time. Young trees are preferred to begin with, and generally trees from three to twelve years' old are considered the best. Old trees are avoided, as they ha bour ants, and the moss on their branches impedes the movements of the worm. The worms feed from about eight o'clock in the

morning till near noon, and again from three till sunset. During the intervening hours, they descend the trunk to bask in the sun, and at night they take shelter under the leaves. A dropping sound like that of light hail is heard under the tree at feeding time, and is caused by the pea-like excrement (*lád*) of the worms, which is constantly falling to the ground.

Enemies and diseases.

21. During their life in the open air the worms are exposed to the attacks of various enemies, among whom the crow and kite are the most persistent and destructive, but the *sáksákia*, or wandering pie, by day, the asiola, or "little downy owl" (*pesa*), and the large frugivorous bat (*bandali*) by night, are also to be dreaded. The insects which do most damage are the wasp, the ichneumon fly, and a red ant called *ámruli*, but the latter is dangerous to the worm only in its earlier stages. The result of a bite is a blackness extending from the injured part over the whole body, which gradually withers away. The cultivators wage war against the ants with fire and hot water, or skewer bits of fish on the trunk to attract them and prevent them from ascending the tree; the pellet bow is used against birds by day, and a tall clapper of split bamboo, pulled by a string from within the watcher's hut, serves to frighten away nightly marauders; but with all these precautions the losses by theft are considerable. This constant watching becomes very troublesome, especially in the months of inclement weather, and is usually left to the children and old people, where there are any in the family. Continued heavy rain is apt to wash the worms off the trees, but they can shelter themselves under the leaves against passing showers, and, in fact, light rain in October and November is considered favourable to the growth of the winter brood. A hailstorm is the greatest calamity of all, for it not only kills numbers outright, but so weakens others that they die before maturity or spin imperfect cocoons, and the weakness is even said to be transmitted to the moth, should any emerge. The worms finally are subject to a disease called "the swelling" (*phula-rog*), for which no remedy is known. In Upper Assam, this epidemic occasionally destroys the worms on acres of *sum* forest together, and even where the mortality is less wholesale, the silk-producing power of the survivors is found to be impaired. The worms often die off in large numbers without any swelling or other external symptoms, merely ceasing to feed, and perishing apparently of inanition, and in this case also the yield of silk from the surviving portion of the brood is poor. Apart from these causes, a difference is said to be noted in the productive powers of worms of the same breed. It is alleged that some worms can be distinguished as destined to die

immature : these are called *kahoya* and *bisa* ; others, called *phutuka*, spin cocoons yielding an imperfect quantity of silk.

The spinning of the cocoons.

22. The period from hatching to maturity varies from 26 days in summer to 40 days in winter. The moultings are completed about a week or ten days before the end of this term. There is no difficulty in discerning when the worm is ready to begin its cocoon, because it invariably descends the tree to the edge of the plantain-leaf band, and there remains motionless, grasping the bark with its holders only, while the fore part of the body is raised and thrown slightly back. Another sign is said to be a peculiar sound yielded by the body when lightly tapped. Worms which show these symptoms are removed at nightfall, or if left over night they begin to make their preparations for spinning in a roll of grass tied round the tree for that purpose. Being carried to the house, the worms are there placed on a bundle of branches with the dry leaves attached, or in a basket with a bundle of leaves suspended over it, into which the worms crawl. From four to seven days are spent in spinning the cocoon.

A complete cycle of the insect lasts about 54 days in the warm months, and 81 days in the cold season. The maximum and minimum periods are shown in the subjoined table :

	Minimum days.	Maximum days.
Hatching	7	10
As a worm	26	40
Spinning cocoon	4	7
In the cocoon	14	21
As a moth (up to laying eggs) ...	3	3
Total	54	81

Treatment of cocoons, and value of cocoons and thread.

23. The *muga* cocoon is in size about 1¾ inch long by 1 inch in diameter. In colour it is a golden yellow ; but there are usually a number of dark cocoons in every brood, for which no satisfactory reason can be assigned. The difference does not seem to be due to any of the conditions of food or breeding. A large proportion of the dark cocoons which come into the market, however, are no doubt to be accounted for by discoloration in the process of firing. Boiling in alkali water is the method employed to restore dark cocoons to their proper colour. With the living chrysalis inside, the cocoon weighs about 66 grains, with the dead and dried chrysalis 27½ grains, and the empty cocoon from which the moth has made its escape weighs 6 grains only. The

ordinary selling-rate for cocoons with the desiccated chrysalis is Rs. 2 the thousand, but they can often be bought in the villages for 700 to 800 the rupee. The waste or perforated cocoons from which the moth has escaped can be had for about Rs. 2 the seer, containing nearly 3,000 cocoons. There is, however, no regular market for cocoons, and persons wishing to procure a stock must visit the villages where the worms are bred, and make their own bargain with the cultivators, and waste *muga* cocoons do not seem to be easily procurable by any artifice.

The silk of the *muga* cocoon is reeled. The life in the chrysalis having been destroyed by exposure to the sun, or by fire, the cocoons are boiled in an alkaline solution. When required for use, their floss is plucked off, and they are placed in a pot of warm or cold water. Two persons are employed, one to take the silk from the cocoons, the other to reel it. The former brings together the filaments of silk from a number of cocoons, varying from 7 to 20, and hands them to the reeler, who rubs them into a thread by rolling them on his thigh with the palm of his right hand and the under part of the forearm (which usually suffers more or less from the operation), while with his left hand he turns the fly-wheel of the primitive reeling apparatus that stands beside him,—an axle turning in the notches of two uprights, with the aforesaid wheel at one end, or often merely a cross-stick in the middle to serve the purpose of a fly-wheel. In this way, the whole of the cocoon can be unwound, except the innermost layer next to the chrysalis. The thread is reeled off on the axle in skeins of about half a seer at a time. The quantity of silk yielded by the cocoons varies according to the brood. The cold-weather brood gives the least, and is usually reserved for breeding, only the inferior cocoons being spun. The *kátia* and *jethua* broods yield the most silk. A thousand cocoons of the *jarua* brood will yield about 2 chitaks of thread, and of the *katia* or *jethua* brood 3 to 4 chitaks.

Opinions differ as to whether old cocoons can or cannot be reeled. The cultivator does not usually keep his cocoons so long as a year, unless he is accumulating a stock very slowly. But it would seem that reeling is practicable up to two years at least, and that, if carefully kept, cocoons of even four or five years' old can be reeled, and will give silk in no respect inferior to that yielded by fresh cocoons. The experiment, however, is one which is not often made.

No part of the *muga* cocoon is rejected as useless : the floss plucked off before reeling, the silk of the shell immediately surrounding the chrysalis, and the cocoons kept for breeding, after the moth has forced its way though them, though unfit for reeling, are spun by the hand into a coarser kind of

thread, called " waste," or *era*, which is used for mixing with *eri* thread, or is woven by itself into rough but warm and durable fabrics.

The price of *muga* thread varies, according to quality, from Rs. 8 to Rs. 12 per seer. The latter is the ordinary rate in Sibságar bazar at present. In 1876 I find the price quoted as Rs. 7. Waste *muga* thread can be bought for Rs. 4 the seer.

The cloth woven from *muga* yarn has a bright yellow colour and a pretty gloss. It stands washing much better than other silks, keeping gloss and colour to the last. It is usually sold in pieces about 5 yards long by 4 feet broad, and the price varies from Re. 1-8 to Rs. 2 per square yard.

A curious tradition is preserved of the *khesa*, or " raw " *muga* silk, which used to be manufactured in the days of the Ahom kings. The worms intended to yield this product were kept alive for three days after completion of their growth, without being allowed to spin their cocoons. The result is said to have been the accumulation of the silk fibre in the body of the worm. Their heads were then plucked off, and the bodies thrown into a vessel of warm water, and, the ends of the fibres being extracted, the silk was reeled off in the ordinary way. This kind of silk was reserved for the exclusive use of royalty.

Markets and extent of production.

24. There is no large market where either the cocoons, the thread or the cloth can be purchased wholesale, but cocoons and thread are to be procured in small quantities at most of the petty village fairs in the *muga*-producing districts, and some stock of cloth can usually be found at the headquarters stations, particularly in Sibságar and its two subdivisional stations of Golághát and Jorhát, the latter of which, in the days of native rule, was the grand centre of the silk industry of Assam. The Marwari traders pick up silk in the villages, and the cultivators also come in occasionally, as their needs impel them, and sell to the traders in their shops ; it is altogether a casual kind of commerce, fluctuating greatly from year to year, but never attaining any regular flow or considerable dimensions. The export of *muga*, unlike that of *eri*, is principally in the form of thread, which goes to Calcutta for local consumption, or for export to the Persian Gulf ; it is too dear for the English market, though the Calcutta prices are quoted as low as Rs. 6 to Rs. 11 per seer.

Muga is less widely spread than *eri*, and the annual outturn is probably less ; but there are no means of estimating its amount. The outturn of the Sibságar district is supposed to be 205 cwt. (280 maunds) of silk (only half the leased *sum* lands being assumed

as actually under *muga* cultivation); that of Darrang is shown as 8 cwt. (11 maunds), and of Kámrúp as 15 cwt. (20 maunds), though Darrang produces more than Kámrúp; but these estimates are quite untrustworthy. Sibságar is the great *muga*-growing district of the Assam Valley; next to that, the south-western portion of the Mangaldai subdivision, and the western part of Kámrúp to the south of the Brahmaputra, where the Rani mauza specially is celebrated for supplying breeding cocoons to Upper Assam. *Muga*-breeding is also carried on to a considerable extent in the closely-populated tract in the centre of the Kámrúp district north of the Brahmaputra. There is a good deal of *muga* cultivation in Lakhimpur, where the *sum* tree grows wild in great profusion; and the more closely-peopled mauzas of Nowgong also contribute largely to the stock of *muga* in the province. The worm seems to be unknown in Sylhet and Cachar, while the hill districts do not produce the trees on which it feeds.

Outturn per acre of *sum* trees.

25. Various estimates have been made of the quantity of silk yielded by the worms fed on an acre of trees. Mr. Hugon reckoned 50,000 cocoons yearly per acre, yielding more than 12 seers of silk, in value Rs. 60, and as there were then 2,000 acres of *sum* trees in Nowgong, the total produce of that district in 1837 would appear to have been 600 maunds, or double that of Sibságar at the present day. The Sibságar estimate, however, rests on the hypothesis of 18,000 cocoons per acre, giving 3 seers of thread. The great discrepancy between these two calculations would appear at first sight to point to a remarkable falling off in the productivity of the worm, but it is probably to be explained by other causes. The number of trees assumed per acre, for instance, makes a substantial difference in the result. The Sibságar mauzadars return the average number as 80, whereas in the plantations of Lower Assam a quarter of an acre sometimes contains a larger number than this. Mr. Hugon, indeed, estimates 4,000 cocoons to a seer of silk, against the modern Sibságar estimate of 6,000; but it is more probable that both guesses are inaccurate than that the *muga* cocoon has decreased in size by one-third during the last half century. As regards the total outturn of the Assam Valley, the earliest information we have is that recorded by the chronicler of Mir Jumla's invasion in 1662, who remarks that the silks are good, but that the people produce little more than they require for use. Mr. Hugon says that the price of *muga* thread rose from Rs. 3-8 to Rs. 5 per seer in the three years ending with 1837, and since then the price has doubled, but we cannot infer a diminished production from this fact alone. The trade was no brisker in Mr. Hugon's time than it is now. Merchants

requiring silk were obliged to make advances to the cultivators. Coming down to the present day, it is impossible to say with certainty whether the cultivation of *muga* has declined or not, but if the general opinion of the country be accepted, it must be believed that a large falling off has actually taken place. The area of *sum*-bearing lands rented from Government in the Sibságar district was 15,907 acres in 1876, against 12,393 acres in 1881, and in Lower Assam also patches of *sum* plantation, evidently intended for the breeding of silk-worms, will often be found lying unused. On the other hand, there is ample room in the Assam Valley for the extension of *muga* cultivation. The virgin *sum* forests of Lakhimpur are capable by themselves of sustaining millions of worms, if the industry should ever receive that quickening impulse of which it stands in need.

Champa and *mezankuri.*

26. An account of *muga* silk would not be complete without a few words on the two varieties assumed by it when the worm is fed on the *champa* (or more properly *chapa*) and the *mezankuri* or *adakuri* (*tetranthera polyantha*). *Champa* silk seems to be quite forgotten now. It is described as a very fine white silk, which used to be worn only by the Ahom kings and their nobles. *Mezankuri* silk is still to be procured, but with great difficulty. In 1881 there does not seem to have been a single piece obtainable in Jorhát. One of the reasons alleged for this falling off is that the new rules restricting clearances in the forests are unfavourable to the growth of the *mezankuri* tree. This tree springs up spontaneously in abandoned clearances, and it is in this early shrub-like stage that it is fit for the worms to feed on. In its second year, the worms fed on it give coarser silk; in the third year, the silk is hardly distinguishable from the common *muga*. Thus, the mature tree is quite out of the question, and as the *mezankuri* is never cultivated, forest clearances were the only places where the breeders could look for young trees. When fed on the *mezankuri*, the *muga* worm spins a fine silk of almost pure white, about thrice as valuable as the common *muga*, in fact, the most costly of all the silks of Assam. The thread was selling at Rs. 24 the seer in Jorhát in 1883. The silk is altogether an article of luxury.

III. THE PAT WORM AND SILK.

The *pat* worm is a *bombyx*, akin to the silkworm of Europe. Under this name are included two distinct species—the univoltine *bombyx textor*, called *bor polu*, or large worm, and the multivoltine *horu polu*, or small worm, of which the scientific name is *bombyx*

crœsi. Both kinds are reared indoors, on the leaves of the mulberry (*morus indica*), called *nuni* in Upper and *meshkuri* in Lower Assam.

(*a*) The larger *pát* (*Bombyx textor*).

27. The peculiarity of the *bor polu*, or large *pát* silkworm, is that the period of hatching lasts ten months. To this circumstance it owes its name of *lehemia*, or slow. During this time the eggs are kept in a piece of cloth deposited in a wicker-basket (*japá*), which is carefully placed out of the reach of rats and insects. The cultivators look for the appearance of the young worms about the time of the festival of the first day of *Magh*, that is, towards the middle of January, when the mulberry is putting forth green shoots.

Process of breeding.

28. The worms are fed at first on young mulberry leaves cut into pieces and shred over them. They change their skin four times. After the second moulting, they are able to feed on entire leaves. A hundred worms in this stage will eat about one seer of leaves in a day. The tending of the worms usually devolves upon the women and infirm members of the family. The life of the worm lasts thirty to forty days, of which ten or twelve days elapse between the final moulting and maturity. The mature worms are removed to a basket divided into compartments, each allotted to two or three worms. Here the cocoons are spun.

The cocoon is completed in about six days. Those selected for breeding are placed on a sieve. The moths emerge in about a fortnight (the time is also stated as ten to twenty days, according to the heat of the weather), and remain in pairs on the sieve for three days, when the females are taken away and placed on a cloth suspended in some quiet corner, where they deposit their eggs and die a day or two later.

About 7 per cent. of the cocoons are reserved for breeding. Their price for this purpose runs as high as one rupee per hundred.

Method of reeling.

29. The cocoons intended for use are placed in the sun, to destroy the life of the chrysalis. This having been effected, a score of cocoons are thrown into a pot of scalding water, and stirred with a splinter of bamboo; the fibres attach themselves to the bamboo, and a thread is thus carried to the reel and reeled off. Sometimes the bamboo fails to pick up the filaments, and a twig of the *makudi* creeper with the leaves on has to be employed.

The cocoon is of a bright yellow colour, but the silk, when boiled in potash water, becomes perfectly white. About 320 cocoons yield a tola of thread, hence 25,000 to 30,000 will yield a seer.

From the breeding cocoons after the escape of the moth, and also from the refuse of reeled cocoons, a coarser thread, called *lát*, is made by spinning. One thousand such cocoons weigh about 4½ tolas, and yield a thread about one quarter as valuable as the same weight of reeled yarn.

The *pát* silk is a much rarer and more valuable article than either *eri* or *muga*, the threads sell for Rs. 16 to Rs. 24 per seer, and the cloth for Rs. 3 to Rs. 4 per square yard. Like the *mezankuri* variety of *muga*, the *pát* silk is rather an article of luxury than of ordinary trade. If a piece is wanted, it usually has to be made to order. Nothing like a market for *pát* thread or cloth can be said to exist. The breeding of the worms is restricted by custom to the Jugi caste, who used to supply the requirements of the Ahom kings and their court, and the industry is hardly known out of the district of Sibságar, the ancient centre of Ahom rule. The Jugis still make a profound mystery of the business, refusing to let a stranger see the worms, and answering enquiries in a manner calculated to mislead. They say, for instance, that the worm takes nine months to spin its cocoon. There can be little doubt that the production of *pát* silk has greatly declined since the annexation of Assam, nor is there any prospect of its revival. Writing to the Government of India in 1877, Colonel Keatinge observed that the question of extending the *pát* silk industry need not be seriously discussed.

(*b*) The smaller *pát* (*Bombyx cræsi*).

30. The smaller kind of the *pát* silkworm gives a white silk, which is reeled into a coarser and less valuable thread than that of the larger; but as the worm is multivoltine, yielding four broods in the year, it finds greater favour with the cultivators, and is, perhaps, supplanting the univoltine variety. It lays its eggs chiefly in December, January, March, April, June, July, September, and October. The eggs are hatched on trays woven from slips of spilt bamboo. An experiment made by Mr. Buckingham, a tea-planter in the district of Sibságar, during the month of June, with an average temperature of 82°F. by day and 76° by night, gave the following results:

June 2nd	...	...	...	Cocoons obtained.
„ 4th	...	...	...	Moths appeared.
„ 5th	...	...	...	Laid eggs.
„ 9th and 10th		...	...	Moths died.
„ 14th	...	...	...	Worms hatched.
„ 17th	...	...	...	First moulting.
„ 21st	...	...	...	Second „
„ 24th	...	...	...	Third „
„ 28th	...	...	...	Fourth „
July 6th	...	...	...	Spinning began.

In this experiment the life of the worm lasted twenty-three days.

The number of fresh cocoons that weighed one pound was found to be 720, and of whole dried cocoons 2,048. It is estimated that 7,200 whole cocoons would yield one pound of reeled silk, but this calculation seems open to question.

The results of an experiment made by Krishna Kanta Ghugua, a native gentleman of the Jorhát subdivision, were as follows :

August	9th	...	Cocoons obtained.
„	16th	...	Moths emerged.
„	18th and 19th	...	Laid eggs.
„	25th	...	Worms hatched.
„	30th	...	First moulting.
September	4th	...	Second „
„	9th	...	Third „
„	16th	...	Fourth „
„	20th	...	Spinning began.
October	6th	...	Moths emerged.

Here the life of the worm lasted twenty-seven days, and sixteen days elapsed between the commencement of spinning and the emergence of the moth.

B.—Wild Silkworms.

31. The *ban muga*, or forest *muga*, is simply the common *muga* worm in its wild state. The cocoons are not plentiful enough to be largely used, but the wild moth is sometimes allowed (like the wild buffalo) to improve the strain of the domestic breed. Female moths of the domesticated *muga* species, if left outside the house in the evening, will be visited by any wild male moths that happen to be in the vicinity. The silk of the *ban muga* is occasionally mixed with *eri* by the Kacharis.

The *ban muga* (*Antheræa Assama*).

32. The wild *attacus cynthia* is believed to be closely allied to the *eri* worm, and in some places is regarded by the people as the *eri* in its wild state. It appears to be commonest in Cachar, but it is also known in Kámrúp. The silk is very rarely used to mix with *eri*.

Attacus cynthia.

33. The *petogore* silkworm is an *attacus* feeding on the *kutkuri* (*vanqueria spinosa*), the word *muga* being added to its name in the generic signification of silkworm. It is rare in the Assam Valley, but common enough in Cachar. It is said to be easily capable of domestication. The silk is never used.

The *petogore muga* (*attacus Atlas.*)

34. There is a wild silkworm of the *pát* species which is found on banyan trees (*ficus indica*) and is sometimes taken and reared by Jugis on mulberry-leaves, like the domesticated worm, to which it becomes

The wild *pát* worm.

thoroughly assimilated in the course of three generations. An experiment made by Krishna Kanta Ghugua gave the following results :

August	14th	...	...	Cocoons procured.
„	19th	...	...	Moth emerged.
„	23rd	...	...	Laid eggs
„	31st	...	...	Worms hatched.

These worms were evidently of the smaller or multivoltine kind. It is not certain whether the larger kind is found in the wild state.

Assamese tusser.

(a) The *kutkuri* (*Antheræa Paphia*).

35. The wild silkworm called *kutkuri* is believed to be the same as the common tusser of Bengal. Its food is principally the *kutkuri* (*vanqueria spinosa*) from which it takes its name, or else the plant called (erroneously) the wild rhododendron (*melastoma malabathricum*), the Assamese name of which is *phutuka*. It has been cultivated in the palmy days of the Assam silk industry, but it is now almost entirely neglected, as being inferior to *muga*, and also, perhaps, because it yields only three broods in the year. Its habits are now known only to a few old people in Jorhát. Mr. Buckingham, to whom I am indebted for most of my information about this worm, says that the *kutkuri* is common in the wild state in the neighbourhood of Jorhát. It is also common in Cachar, but there also no use is made of it. Mr. Buckingham notes the following experiment with this silkworm :

June	16th	...	...	Obtained the moth.
„	17th	...	...	Eggs laid (378).
„	23rd	...	...	„ hatched.
„	28th	...	...	First moulting.
July	3rd	...	...	Second „
„	7th	...	...	Third „
„	13th	...	...	Fourth „
„	18th	...	...	Spinning began.

The worms were fed on the *phutuka*. Worms put outside while very young were speedily devoured by ants; but if kept indoors till the second moulting, they were then found to do very well on the bushes. Mr. Buckingham adds—

I reared ten worms in this way, and all except one made their cocoons between the leaves of the shrub, one solitary worm descending and making its cocoon in the grass. The natives had previously informed me that this wild species of worm was less liable to the attacks of crows, bats, &c., than tame species were, and it was curious to watch how the worm, at the slightest show of danger, let go the leaf or stem with all its front legs, hanging on by its holders behind, and in this position, with its head slightly curled round and its front legs well tucked up, it took an experienced eye to detect the difference between the leaf of the tree and the worm.

An experiment made by Krishna Kanta Ghugua with worms got from the jungle in September gave results as follow:

October	7th	Spinning began.
April	10th	Moth emerged.
„	12th to 15th	Laid eggs.
„	23rd	Worms hatched.
„	29th	First moulting.
May	4th	Second „
„	10th	Third „
„	15th	Fourth „
	21st	Spinning began.

According to this experiment, the chrysalis state of the moth lasts six months.

The only point in which the *kutkuri* cocoons seemed to Mr. Buckingham to differ from those of the Bengal tusser was that the tusser cocoon was rather closer spun and more compact, and less pointed at the ends than the *kutkuri*; but the colour was as nearly as possible the same.

The silk is ranked below *muga* in value, being coarse though glossy, and so strong that the natives compare it to rhea thread. The *phutuka* is one of the commonest wild shrubs in Assam, and the worm could probably be cultivated at very little cost, but the silk could not compete with the cheaper and better tusser supplied by Bengal.

The *deomuga*.

36. Another worm which appears to be simply a variety of the tusser, feeding on the *phutuka* like the worm just described, is counted by the Assamese as a distinct species, and known by the name of *deomuga*. It must not be confounded with the genuine *deomuga* described further on. An experiment made with cocoons of this (so-called) *deomuga* by Krishna Kanta Ghugua furnished the following record:

August	14th	Cocoons obtained from the jungle.
„	17th	Moth emerged.
„	19th, 20th, and 21st	Laid eggs.
„	27th	Worms hatched.
„	31st	First moulting.
September	5th	Second „
„	10th	Third „
„	15th	Fourth „
„	22nd	Spinning began.
March	13th	Moths emerged.

Here also the period of the chrysalis was about six months.

Some of the cocoons were boiled in potash water for two hours, and a fine thread, resembling that of the *muga*, was reeled off them.

37. The wild silkworm called *sálthi* is also a species of tusser. It is called *deomuga* by the Kacharis, but must not be confounded with the *deomuga* proper, which is described below, and which is a *bombyx*. The *sálthi* worm feeds on the *kamranga* (*Barringtonia racemosa*) and the *hidal*. The worm itself is very rarely met with, but herdboys and woodcutters occasionally bring home the cocoons, and the silk obtained from them can be used for mixing with *eri*. To extract it, the cocoon has first to be boiled in a strong alkaline solution, and afterwards bruised in a mortar. The hollow cocoon is often converted into a tobacco-box, or is used to keep lime in for eating with the betelnut, or as a cup for dipping oil out of a jar. The habitat of the worm is the jungle at the foot of the Bhutan Himalayas. The chrysalis of this species, as of all the wild silkworms, is eaten with much relish by the Kacharis.

The *sálthi* (*Antheræa Paphia*).

38. The *ámluri* or *ámpotoni*, so called from the mango, or *ám*, tree on which it feeds, is one of the commonest wild silkworms of Assam. It occurs in the Assam Valley under both the northern and the southern hills, and likewise in Cachar, where the wild tea-plant often supplies it with food It is also frequently found on *sum* trees. Its favourite tree, however, is the mango, whether the wild mango of the forest, or the cultivated trees in the vicinity of villages. The *ámluri* spins a bright yellow cocoon, in clusters so closely interwoven that they cannot be separated for reeling, which, indeed, their very texture prohibits. It is said that a single tree will sometimes furnish as much as a maund of cocoons. In the number of broods and times of breeding this worm is said to correspond with the *muga*. The *kátia* brood (October—November) is the most plentiful in Kámrúp. Subjoined is the record of an experiment made with some cocoons of this worm by Khrishna Kanta Ghugua:

The *ámluri or ámpotoni* (*Cricula trifenestrata*).

September 15th	Cocoons obtained (from a *sum* tree).
„ 26th	Moth emerged.
„ 27th, 28th, and 29th ...	Laid eggs.
October 4th	Worms hatched.
„ 14th	First moulting.
„ 16th	Second „
„ 23rd	Third „
„ 29th	Fourth „
November 15th	Spinning began.
December 6th	Moth emerged.

The silk of the *ámluri* is almost worthless. The cocoon is one of a thin and open texture, yielding very little silk. It cannot

be reeled. The worm is covered with hairs, which produce irritation of the skin, and for this reason it is regarded as unclean by the Hindus; but Kacharis, Rabhas, and Meches occasionally mix the silk with *eri*, where it reveals its presence by the itching it causes. This irritating property of the worm is said to protect it against crows and bats. The chrysalis, however is eaten by Kacharis, Rabhas, Meches, and Mikirs. A smaller variety of the *ámluri*, called *bisha*, and feeding, like the *ámluri*, on the mango tree, is found in small numbers in the sub-Himalayan jungles of Kámrúp. The name expresses the irritating quality of the worm.

The deomuga (Bombyx religiosæ).

39. The *deomuga* silkworm is so called from its size. It is the largest of all the worms, attaining a length of 6½ inches, and it is also the handsomest. Mr. Buckingham writes:

> This worm appears at times on *sum* trees with the common *muga*, but it is of rare occurrence. The worm in its second and third stage is particularly handsome, with rows of turquoise spots on each side. When the worm enters upon its fourth stage, the turquoise spots vanish, and spots of gold appear in their place, and on each side of the body stripes having all the colours of the rainbow tend to make this worm by far the most beautiful of its tribe.

The *deomuga* worm is said to live thirty days, and to spend three days in spinning its cocoon; the period of the chrysalis is fifteen days in the hot and thirty days in the cold season, and the life of the moth lasts about four days.

The cocoon is large (3 inches × 1½ inch), and gives a large quantity of strong but coarse and dark-coloured silk. The hardness of the cocoon renders it difficult to reel, and the silk easily gets into knots. The thread of the *deomuga* is said to be used for fishing-lines in Bengal.

In Cachar the *deomuga* feeds on the banyan (*ficus indica*) and pipal (*ficus religiosa*). The worm occurs generally in the Assam Valley.

Actias selene.

40. The silkworm known by the scientific name of *actias selene* occurs in Cachar, but very rarely. The cocoon yields but little silk, and no attempt is ever made to use it.

COTTON IN ASSAM.

By H. Z. DARRAH, Esq., *I.C.S.*, 1885.

Description.

Gossypium Herbaceum.—An erect shrubby plant belonging to the tribe Hibisceæ, of the natural order Malvaceæ; annual or perennial, more or less hairy. Stems 4-6 feet high, woody. Leaves stalked, stipules falcate, lanceolate; blade about as long as the petiole, cordate at the base, palmately lobed, lobes 5-7, ovate, or lanceolate acuminate. Peduncles auxillary, jointed, rather shorter than the leaves, one-flowered. Bracteoles 3, large, cordate, dentate or nearly entire. Flowers large, yellow or white, with a purple centre. Calyx truncate or obscurely toothed, shorter than the bracteoles, usually beset with black glandular dots. Petals obovate, cuneate, spreading. Stamens numerous, monadelphous; anthers one-celled, style clavate; stigmas 3-5. Capsule ovate, pointed, 3-5 celled. Seeds about 5 in each cell, ovate, covered with closely adpressed greyish or greenish down under the long white woolly hairs.—(*Duthie.*)

Accurate statistics unobtainable.

1. Owing to the absence of any establishment for registering agricultural statistics over the greater part of the Province of Assam, it is almost impossible to frame an accurate estimate of the area under a particular crop. This is the more difficult in the case of cotton, because in the plains of the Assam Valley, where alone the rudiments of a registering system are to be found, the crop is almost unknown. In the hill districts, on the other hand, where no registering agency of any kind exists, cotton forms a very important article in the annual agricultural outturn, and the absence of any means of accurately gauging its amount is, therefore, the more to be regretted.

Cultivation in Assam Valley.

2. In the plains, patches of cotton are met with here and there. The Miris of Lakhimpur and Sibságar grow a little for their own domestic consumption. In some mauzas of the northern frontier the cultivation of cotton on the lower slopes of the Bhutan Hills, and in the light soil at their foot, used once to be carried on extensively. It was known as *gári* cultivation, and the Chapaguri mauza in Kámrúp was once famous for it. In the Goálpára district some cotton is grown in the hilly portions of the Sidli and Bijni parganas. In Kámrúp, *jhúming* is carried on for cotton to a limited extent on that portion of the Khási Hills which is included within the district. The only district in the Assam Valley which grows cotton largely is Nowgong. The exception is due to the fact that the range of the Mikir Hills is included within its boundary. The Mikirs grow cotton, not only for domestic consumption, but also for export, and boat-loads of it may be seen going down the Kopili and Kollong towards the close of the cold weather.

3. Similarly, in the Surma Valley, cotton is only occasionally cultivated in the plains districts. The Mikirs and Tipperas grew some by *jhúming* in pargana Mulagul in Sylhet. About 50 acres are supposed to be under cotton in Sunámganj.

Cultivation in Surma Valley.

The area under cotton in Cachar is high, but that is because the district includes the subdivision known as the North Cachar Hills, which are really a portion of the Central Assam range. Here cotton is largely grown for export as well as for local consumption, by hill Kacharis, Nágas, and Kukis. The sadr subdivision grows but little cotton. It alone is considered in the estimate given in paragraph 4.

4. Altogether, however, the cultivation of cotton in the plains districts of Assam is, with the exception of that in Nowgong and the North Cachar Hills, totally insignificant. In the regular plains it may be said never to be cultivated at all; but where the slopes of the adjacent hills are included within the borders of these districts, cotton is grown to a limited extent. The following table gives approximate estimates for the area under cotton in the Brahmaputra and Surma Valleys:

Total cultivation in plains districts.

		Acres.
Brahmaputra Valley.	Goálpára	1,622
	Kámrúp	248
	Nowgong	3,286
	Darrang	388
	Sibságar	88
	Lakhimpur	100
Surma Valley.	Sylhet	900
	Cachar (sadr subdivision) ...	500
	Total	7,132

5. In the three hill districts of the province, and the subdivision of North Cachar, however, the case is quite different. In the range of mountains which extends from the head of the Brahmaputra Valley to the confines of Mymensingh, cotton is nearly everywhere a staple crop. The one exception is the high plateau of the Khási Hills, where the climate is too cold. The Gáros grow it in very large quantities. The inhabitants of the Khási and Jaintia Hills carry down hundreds of maunds every year to Kámrúp and Nowgong. The Nágas (Lhotas and Rengmas) export partly to Nowgong, but principally to Sibságar.

Cultivation in the hills.

6. It is much to be regretted that no reliable details can be given as to the cotton area in this central range. The revenue is not collected upon a measurement of the cultivated lands of the villages. It is assessed

Method of estimating.

upon the individual, or the house or the hoe. There is no agency for collecting crop statistics, and the land has never been surveyed with this object in view. The result is that estimates as to the area under cotton in the hills are little more than probable guesses, depending more on the intelligence of the officer who makes them than upon anything else. The usual system has been to ascertain, by enquiries at the various submontane fairs, the quantity that has been exported in a given year. An addition is made for the amount taken out of the country by traders who do not visit the fairs, and also for the amount believed to be locally consumed. The result gives the probable quantity produced. This is divided by the assumed outturn per acre and an estimate of the area formed. In one district (Khási and Jaintia Hills), the quantity that passed along the main routes was registered for six months. To the figure thus obtained was added an allowance for what probably went along unregistered routes, and the total, being divided by the assumed outturn as above, gave the area. The following figures may be taken as approximations to the actual area under cotton in the hill districts :

	Acres.
Gáro Hills	22,933
Khási „	1,250
Jaintia „	3,500
North Cachar Hills	4,000
Total	31,683

No estimate has been given for the Nága Hills, as no attempt has so far been made to collect any statistics in that district, save a few relating to export.

Total cultivation in the province.

7. Adding together the figures for the plains and hill districts, we obtain, as the total area under cotton in the province, 38,815 acres.

Varieties.

8. The varieties of cotton are not numerous, but the names by which the crop is known differ from district to district, and peculiarities of soil, climate, and method of cultivation, have no doubt produced divergences from the original type. It is not easy, therefore, to say exactly how many really different kinds there are. Roughly speaking, there are two well-marked varieties :

(1) The large-bolled high-growing cotton, known as *dhal* (white flowers) in Lakhimpur, as *boga kapáh* in the Majuli, as *khungi deva* in Cachar,* as *kil* in the Gáro Hills, and as *bor kapáh* (lit., large cotton) in Nowgong. Probably also the same as the *bhugai* of Sylhet. In Nowgong, this species is grown on level

ground, has a smaller number of seeds than the second variety (mentioned below), can be ginned more easily, can be plucked twice a year instead of once, and bears for three seasons. The *kil* of the Gáro Hills is very nearly the same, except that the crop is annual, that it is grown everywhere on the hill sides, and not confined to level ground, and that it can only be plucked once a year. The pods are very large, sometimes as much as 8 inches in length, and when they burst, the contents come out in a cataract of cotton which gives a field the appearance of being covered with snow. This variety is, however, not as much in request for ordinary purposes as the smaller kind. The fibre is said by the trade to be harsh and to twist badly. It is better adapted for mixing with wool than for any other purpose.

(2) The small, round-bolled species, known as *shet* (reddish flowers) in Lakhimpur, as *thumsa* in Cachar,* as *u kynphád* in the Jaintia Hills, and as *horu kapáh* (lit., small cotton) in Nowgong, possibly identical also with the *chotsá* of the Angámi Nágas. This species is sown annually, and can only be plucked once a year. The Lakhimpur variety has pale reddish flowers. That grown in the Jaintia Hills is said to be the best cotton produced in the province. Its thread can be more closely woven than that of other kinds. The Nága Hills variety is rated lowest of all, being very short in the staple, and coming into the market in a very dirty condition.

Soil.

9. Cotton is most generally grown on forest clearings known as *jhúms*. The hillmen, as a rule, prefer bamboo and grass to tree jungle. The latter is more difficult to work, does not burn as thoroughly, and leaves obstructions in the shape of stumps and logs. The Kukis of Cachar, however, appear to prefer making their clearings in timber, and the Mikirs of Nowgong choose young forest, with saplings when they can. The soil should be calcareous, and the situation sunny. In the Gáro Hills a species of small bamboo grows with great luxuriance, and the soil on which it is found is invariably selected, if the other conditions for cultivation are favourable. No manure is ever used, except the ashes of the burnt jungle. One reason why the bamboo is so appreciated by the Gáros is that it burns with much more completeness than tree jungle, and therefore affords better manure.

* NOTE.—There is a pale *khaki* variety in Cachar and Manipur known as *kungayás* in the former and as *tissing anguangba* in the latter district. The pods are not a uniform *khaki*, but contain a few white threads here and there.

Hoeing.

10. Land is never ploughed for cotton, except in the few places where it is grown in the plains. In these the ground is ploughed three or four times, and then hoed once, the latter process being considered indispensable in Mangaldai. A trench for drainage is usually dug round the plot. The hillmen always use the hoe, as the slopes on which cotton is grown are too steep for cattle to be employed. Moreover, between the stumps of trees and the half-burned logs which often litter the ground, a plough could not be worked. The Nágas generally give two hoeings, the Tipperahs and Gáros none at all. The other tribes generally hoe once. The jungle is usually cut in the cold weather, and allowed to dry on the ground. It is burnt in March or April, and then as a rule hoed. As soon as possible afterwards the cotton is sown. It is scattered broadcast generally, not put down in drills. The Tipperahs and Gáros have a different custom. After the burning is finished, they go over the land with a pointed stick, and making small holes in the ashes drop a seed into each. In Cachar a similar process is employed, the seed being dibbled in with a pointed stick called *kuar*. In the first year only one kind of seed is placed in each hole. The soil is not further disturbed. It is fertilised by the ashes on the first shower of rain. If the rain is delayed, the value of the ashes as a fertiliser diminishes considerably.

Associated crops.

11. The associated crops are usually broadcast rice and *til*. But some varieties, *e.g.*, *tuhmsa* of Cachar, are always sown alone. The other varieties are also sometimes sown alone; but, as a general rule, other crops are mixed with cotton,—mustard, Indian-corn, chillies, brinjals, linseed, jute, watermelons, are all used according to the wishes or convenience of the cultivator. But *áhu dhán* (unirrigated, broadcast rice) is the most commonly associated crop. In the Gáro Hills, the usual practice is for *áhu dhán* to be sown broadcast the day after the fire. When the shoots show themselves above ground, the vacant spaces become apparent, and these are sown with cotton in the manner already described. The Rengma Nágas sow the cotton broadcast, with *áhu dhán*, the cotton seeds and the *dhán* being mixed up in the same basket. The reason for associating a second crop with cotton is said to be that the latter always grows best if shaded in the beginning.

Occupation.

12. A jungle-clearing is rarely cropped for more than one season with cotton. In the second year upland rice is often sown alone, and when the crop has been gathered the *jhúm* is usually abandoned. If there is suitable land available in reasonable quantities, the clearing is not resumed

for ten years. In no case is it re-occupied until at least five years have elapsed. No rotation of crops is ever observed. In Cachar, in the second year, the paddy straw of the previous year is burnt off, and, the land having been cleared and turned over with the *kuar*, rice and sesamum mixed are sown broadcast. A few days later Indian-corn and cotton mixed with earth are sown, and the ground is kept weeded till August. The Indian-corn ripens in July, the rice in August, the sesamum in November, but the cotton not till December. A similar course is followed in the third year, and in the fourth the land is abandoned. The Angámi Nágas, however, frequently crop a clearing with cotton for two or three years, according to the richness of the soil. The variety of *áhu dhán* known as *tidi* is generally sown by them the first year, while in the second year the kind called *teke* is usually planted. The Rengma and Lhota Nágas, who are the principal cultivators of cotton in the Nága Hills, never crop a clearing with cotton for two successive years.

Irrigation and weeding.

13. Irrigation is hardly ever practised, though occasionally required. The land is usually weeded once or twice, rarely oftener. When the crop germinates, sacrifices of eggs are offered by the Mikirs to the god Longlo Ahi. Similar ceremonies take place when the plucking begins.

Plucking.

14. Plucking generally begins about November. It is usually over in January. *Kunghideva* is plucked from time to time as the pods open and burst. With *thumsa* the plucking is usually made once for all. The *bor kapáh* of Nowgong is plucked twice—once in December and January, when the crop is called *bataria kapáh*, and once in May, when the produce is known as *fetharih kapáh*. As a general rule, plucking lasts for about a month and a half, and usually an interval of three to six days is allowed to elapse between each picking.

Injuries.

15. Cotton suffers considerably if rain holds off for long after it is put into the ground, as much of the seed does not then germinate. On the other hand, heavy rain when the plant is well grown rots the stems, and if the pods have formed, injures the cotton within. Cloudy and damp weather is always injurious, except at the very beginning, and for this reason the sunniest spots are invariably chosen. Insects also do a good deal of injury. Whole crops are sometimes destroyed by the *chilapok* of Lakhimpur, the *pholo jinghi* of the Nowgong Mikirs, and the *mitchi* of the Nága tribes. White-ants often cause serious loss in the Jaintia and Nága Hills.

Average produce per acre.

16. The average produce of cleaned cotton per acre is a very difficult question to solve. From the nature of the crop, the experiment must extend over a considerable time, and it is impossible to have the field under trial watched night and day. Several experiments have, however, been made. Twelve of these in the Jaintia Hills, on plots of a quarter of an acre each, yielded a minimum outturn of 80 lbs. of cleaned cotton to the acre, and a maximum of 304 lbs., the average being 171 lbs. The Cachar estimate is 160 lbs. of cleaned cotton per acre. In Nowgong, experiments made by Inspectors of Police on areas of one *bígha* give an average of 150 lbs. cleaned cotton to the acre. In Sibságar the estimate is 128 lbs. In Goálpára 378 lbs. to 450 lbs. of uncleaned cotton, or about 150 lbs. to 180 lbs. of cleaned. The latest and most careful experiments in the Gáro Hills, made upon 4 acres of land, gave 507 lbs. of uncleaned cotton to the acre. At the Gáro Hills' proportion of 20 seers cleaned cotton to the maund of uncleaned, this would give nearly 260 lbs. of the former to the acre. Even at 16 seers to the maund, the produce reaches the high figure of 202 lbs.

Accordingly, for the whole province, 150 lbs. of cleaned cotton to the acre may be assumed to be a fairly accurate estimate.

Proportion of cleaned to uncleaned.

17. In working out the above, the original figures, which of course show uncleaned cotton, have been converted into cleaned on the assumption that 5 maunds of the former will yield 2 maunds of the latter. As a matter of fact, this estimate is rather under than over the mark. Using the ordinary native cotton gin, repeated experiments have given the outturn as 17, 17½, and 18 seers to the maund, whereas the proportion assumed above is only 16 seers to the maund. The Deputy Commissioner of the Gáro Hills, experimenting with an English ginning machine, gives 20 seers to the maund as the correct proportion. On the other hand, experiments tried in Sylhet, with the view of making the export business pay, gave an outturn of but 16 seers to the maund. It may therefore be assumed that a proportion of 2 to 5 is certainly not in excess of the fact.

Outturn in other parts of India.

18. Comparing the results of the last two paragraphs with experiments made in other provinces, it would seem that Assam cotton gave both a larger outturn per acre and also a larger proportion of fibre to seed, than the cotton of most other parts of India. In the Punjab, the average outturn per acre of cleaned cotton is believed to be but 103 lbs., and the cleaned fibre is said to weigh only from one-fourth to one-third the whole contents of the pod. In the

North-Western Provinces the outturn per acre has been estimated at 65 lbs.; but this is stated to be based on report, not experiment, *and is believed to be much under the truth.* The ratio of cleaned to uncleaned is also taken very low, and is said to be not more than 13 seers to the maund. According to local computation, in Bombay 82 lbs. of cotton per acre is a 16-anna crop, and in 1884-85 the maximum yield of the American varieties was only 66½ lbs. In 1880, however, the highest return reached 170 lbs. per acre. In the Hyderabad Assigned Districts the average outturn is remarkable, for in the three years preceding 1883 it is taken at 20, 25, and 22 lbs. per acre, while the uncleaned cotton is reported to yield no more than one-fourth of its weight of fibre.

Cleaning.

19. The first step in the process of manufacture is cleaning, *i.e.*, separating the fibre from the seed. This is usually done in Assam by an instrument called *neothani* (নেওঠনি) in Upper and *neotha* (নেওঠা) in Lower Assam. It is exactly the same in principle as the *charkhi* of Upper India, and consists of two horizontal rollers, one close above the other, generally both of wood, mounted on an upright stand. One end of one roller is formed into a screw, which catches a projection in the other, and causes both to revolve in opposite directions when the handle at the other end is turned. Sometimes the ends of both rollers are alike and screw-shaped. The cotton passes through, being caught by the rollers, but the seeds, being unable to get through the narrow slit, are left behind. Sometimes a comb formed of the teeth of the "Bhorali" fish is used to partially clean the cotton before it is passed through the *neothani*. Experiments have shown that this machine gives a result of from one seer to two-and-a-half seers of cleaned cotton per diem. The cotton must be dried well in the sun before being ginned, or the outturn will not be good. In some places the seed is utilised as cattle-food. In the parts of Kámrúp near Gauháti it is a regular article of sale. Its price in the neighbourhood of Tura in the Gáro Hills is 10 annas a maund. But this is not general. It is usually flung away as useless. If it were of more value in this country, it is probable that less uncleaned cotton and more cleaned would be exported. But partly owing to the scarcity and dearness of labour here, partly owing to the small value attached to the seed, together with the fact that labour is comparatively cheap in Calcutta and the seed there largely in demand, cotton is exported chiefly in the uncleaned state.

Scutching.

20. After being cleaned, the cotton is subjected to a process of beating (*dhuna*, ধুনা) by means of a bowstring, in order that the fibres may separate, and become loose enough to be spun into thread. The bow (*dhanu*,

ধনু) is usually a piece of bamboo, about 3 feet long; the string (*jor*, জোর) consisting of a twisted strip of the outside of the midrib of a plantain leaf. The bow is usually held so that the string may touch the cotton. The string is pulled and let go, and the vibration separates the fibres. The principle is precisely the same as that used in most parts of India.

There is no special caste in the province, like the Dhunia of the North-Western Provinces and the Pinja of the Punjab, whose occupation it is to prepare cotton for spinning in the manner described. Each household scutches, if the process may be so called, as much cotton as it requires for its own purposes.

Pánjis.

21. After scutching, the cotton is made into little rolls (*panji*, পাঁজি) about 3 or 4 inches long. This is done by placing a small handful on the ground under a slip of bamboo 4 inches long, and then rolling it round with the open palm. The slip of bamboo is removed, and the roll is ready for use.

Spinning.

22. The spinning-wheel (*jatar*, জতর) is practically the same as that used in the Punjab and North-Western Provinces. It consists of a frame supporting two long uprights at one end and two small ones at the other. The long uprights are pierced about 15 inches from the ground by the axle of the wheel (*cháka*, চাকা), which is about 18 inches in diameter. The wheel is generally composed of two separate frames, constructed each like a cart-wheel, with spokes of flat wood, and a circumference of twisted cane. The circumferences of these two wheels are united by a network of cane and on the surface thus formed a cord (*mál*, মাল, or *jatarar batia*, জতরর বতিয়া) revolves, which passes also round a spindle (*sala káthi*, সলা কাঠি, or *batia*, বটিয়া) hung between the two smaller uprights. When of this description, the wheel is known, not as *cháka*, but as *chatni* (ছাটনি). If of a single frame of wood, it is called *sáriá* (সরিয়া), from *sár*, heartwood. Each revolution of the wheel involves 8 to 12 revolutions of the spindle. The latter is a thin strip of iron or bamboo with a fine point. In working the machine the operator applies one of the small rolls of cotton with her left hand to the point of the spindle, at the same time turning the handle of the wheel with her right. The motion thus imparted to the spindle causes it to seize a fragment of the roll, and, as the operator raises her arm to its full length, a thread is formed. A slight change in the direction of the extended arm causes the newly-formed thread to roll up round the spindle, and the roll is thus brought down to the point of the spindle again, whereupon the operation is repeated.

Home-spun thread.

23. From a description of the process, it is clear that good thread can but rarely be spun. It is almost always uneven and rough, often imperfectly twisted, and altogether unsuitable for any but the coarsest cloth. There is practically no trade in the thread, as English yarn is driving it fast out of the market. All over the hills, however, the people spin their own thread. So also do the Miris and those inhabitants of the plains who grow cotton for themselves.

Weaving.

24. In whatever way the thread may have been obtained, the next step consists in weaving it into cloth. This very tedious and somewhat elaborate process is still largely practised over the whole of the province. The loom (*sál*, শাল) used is the same for cotton as for silk, and is an instrument very difficult to describe without a model or an illustration. Like scutching and spinning (*kátá*, কাটা), weaving (*bua*, বুয়া) is confined to the female members of the family. There is no caste to whom it is a calling, as each household prepares its own cloth.

Smaller weaving instruments.

25. The following instruments, besides the loom itself, are used in weaving:

1. *Latai*, or *hat-latai* (লাটাই, বা or হাত লাটাই).—This is a small cone-shaped frame, about 2 feet long, formed of thin bamboo slips. The base of the cone consists of a couple of pieces of wood fixed at right angles to each other. A long strip of bamboo passes from the point through the centre of the base, and projects below it about 14 or 15 inches. The frame does not revolve on the handle so formed.

2. *Chereki* (Kámrúp *cherki*, চেরকী, Upper Assam *chereki*, চেরেকী) —A frame somewhat similar to the above in size, but differing from it in being shaped like a truncated cone, and in revolving on the centre strip of bamboo, which is usually over 2 feet long.

3. *Ugha* (উঘা), or in some places *paghe* (পাঘে).—A small frame formed, like the others, of strips of bamboo, but shaped like an elongated barrel. It revolves on a centre handle. Altogether about 2 feet long.

4. *Bhaunri* (ভাউরি).—A flat piece of wood cut in the shape of a figure of eight, with a bamboo handle, about a foot long, passing through the centre and projecting about 6 inches on each side.

5. *Karhani* (কাঢ়নি).—This instrument is usually about 10 or 12 inches long, including the handle. In shape and size it resembles a hair brush with a short thick handle, and the centre of the blade hollowed out. Along the eight edges of the hollowed portion are arranged thin tubes of bamboo revolving freely on small strips of the same material. In the middle are some three or four cross-pieces of wood, each with a short thin tube of bamboo revolving on it. These divide the interior into four or six or more compartments, according to the number of cross-pieces. The object of all this ingenuity is to prevent the thread being broken by friction, while the warp is being prepared. One thread passes through each compartment, and

in whatever way the instrument may be held it is impossible for the thread to touch anything but a revolving tube of bamboo.

6. *Ras* (রাস).—This is a sort of comb. The teeth consist of very fine strips of bamboo, fastened at each end between two long pieces of the same material. The teeth are just far enough apart to allow easily of the passage of a thread.

Sizing, reeling, and winding.

26. If home-made thread is to be used for weaving, the first process after spinning is the transfer of the rolls of thread, called in Kámrúp *pákri* (পাকড়ি) in Upper Assam *sutá láhi* (শুতালাহি) as they come from the spindle to the *hát látái*, that they may be sized (মাড়দিয়, *már diá*). For this purpose, the thread is simply wound round the *hát látái*, and thereby made into a skein, which is boiled in rice water. Bought yarn is sized, if necessary, in the same way. After sizing, the skeins are transferred to the *chereki*. They are simply slipped down from its narrow towards its thick end. The change is made, because the *hát látái* does not revolve on its handle, whereas the *chereki* does. That portion of the thread which is intended for the warp (*dig*, দিগ) is then wound on the *ughás*. Usually six or eight are used at a time, and an equal quantity of thread is generally wound on each. That portion of the thread which is intended for the woof (*báni*, বানি) has to be made into small spools (*máhura*, মহুড়া) to fit the shuttles. This is done in three ways :

(*a*) Sometimes the *bhaunri* is taken, and a small tube (*mahurá káthi*, মহুড়া কাঠি, *bakuli bári*, বকুলিবারি, or, more generally, *nal-káthi*, নলকাঠি) of bamboo or of reed (*nal* or *ekra*) slipped on the thin end of the *bhaunri*. The end of the thread is attached to the tube, and, the *bhaunri* being twisted in the finger, the thread is wound round the tube. The figure-of-eight shaped piece of wood gives the necessary weight, and enables the twisting process to be carried on without much strain on the fingers. Women constantly prepare these spools for the shuttles while working the rice husker (*dheki*) with one foot and nursing a child in the arms. When enough thread has been collected on the tube, it is slipped off the *bhaunri* and on to the needle (*garbha kila*, গর্ভখিলা, or *garab kila*, গরবখিলা) of the shuttle.

(*b*) Sometimes the shuttle spools are made on the spinning-wheel. In this case the *chereki* is stuck in the ground near the wheel, and the thread wound off on to the spindle. When enough has come off to form a spool, the whole is slipped off the *sala kati*, and the needle of the shuttle passed through the hole occupied a moment before by the *sala kati*. The needle is then replaced in the shuttle.

(*c*) Sometimes the tube of bamboo or reed is slipped on to the end of the spindle and the thread wound round it by turning the handle of the spinning wheel.

27. The next process is the preparation of the warp. For this purpose an even number of *ughás*, usually six or eight, but always between four and twelve, are stuck upright in the ground, at a convenient distance from five bamboo pegs. These in the following description are indicated by the first five numerals. Nos. 1 and 2 are close together, and so are 3, 4, and 5. Peg 4 is usually shorter than the others. Pegs 1 and 5 are heavy and strong, about 3 feet high and 1½ inches wide. They are known by the following names:

The warp.

1 and 5 = *Báti kára khuti* (বাটি কড়া খুটি।).

2 and 3 = *Khuti chiri** (খুটি চিরি।).

4 = *Kutani chiri* (কুটনি চিরি।)

All are in one line. The distance between 1 and 5 is the actual length of the intended cloth, whatever that may be. This rarely exceeds 8 or 9 yards, as the pegs are nearly always planted in the interior of the courtyard of a house. The intended width of the piece of cloth being known, this distance is marked off on the *ras*, and the teeth counted. There must be as many pairs of thread in the warp as there are teeth in the piece of the *ras* marked off. One thread from each *ughá* is passed through a compartment in the *karhani*, and then all the threads are united in pairs. Thus, if there are 4 *ughás*, there will be two pairs, if 6 *ughás* three pairs. The loops thus formed are put over peg No. 1. The *karhani* is carried in the right hand, and the operator walks to No. 5 peg with it, drawing threads from the *ughás* as she moves along. Considering the sides of the pegs next the operator as the inside, and those furthest from her as the outside, the manner in which the threads are carried round is this:—From No. 1 they are taken outside Nos. 2, 3, 4, and 5, then back inside Nos. 5, 4, 3, and 2, and outside No. 1. Then inside No. 1 and back outside Nos. 2, 3, 4, and 5, and so on. The result is that there is one intersection between Nos. 1 and 2, and no other. But in order to work the shuttle, more intersections are necessary. These are introduced as follows: A woman (weaving is never done by men) sits down when the work begins with No. 5 in front of her, and takes up between 4 and 5 one of the threads which has passed inside of No. 5 with her finger and thumb, the latter being on the side of the thread next No. 5. She then turns her hand round, so as to seize the continuation of the same thread on the other side of No. 5, but again with her thumb against the inner side of the thread. The process is repeated with each pair of threads below, till as many as have up to the moment been passed round the pegs are taken up.

* *Chiri* (চিরি) in Upper Assam. *Cheri* (চেরি) in Kámrúp.

It is evident then that at this point there are three intersections in the threads: one between thumb and forefinger of the woman at work, one between forefinger and No. 4 peg, and one between Nos. 2 and 1. It is also evident that if the operator raise her hand, the threads will slip over the short top of No. 4, and on the hand being put down again, the intersection between forefinger and No. 4 will have passed to between Nos. 4 and 3, and the intersection between the thumb and forefinger will have become one between Nos. 5 and 4. This is exactly what is done, and the operator, releasing the threads she had held, takes up the next set which the *karhani* puts round No. 5. It is hardly necessary to remark that it takes far less time for the intersections to be made in the manner described than for the operator with the *karhani* to take the threads once round all the pegs.

The warp, continued.

28. When the warp has attained the right width, the threads are broken off and fastened in pairs round No. 1. Then all the pegs are taken out of the ground, and the warp carefully rolled up round Nos. 1 and 2, while the places of Nos. 3 and 4 are taken by thin laths of bamboo called *chiri* (চিৰি) or *cheri* (চেৰি). A woman sits down in front of No. 5, now placed horizontal on the ground, and proceeds to bring the loops through the teeth of the *rás* one by one. This operation is usually performed by means of the spindle of the spinning-wheel in Kámrúp, but in Upper Assam generally by a flat instrument called *hákata* (হাকটা) of buffalo-horn, brass, or ivory, shaped like a small bill-hook, and about seven inches long. The fine point of the instrument is inserted through the teeth of the *rás* and the loop required drawn back through the aperture. One loop goes through each opening between the teeth. As the loops come through they are arranged upon a thin rod of bamboo, called *guri* (গুড়ি) in Kámrúp and *sali* (সলি) in Upper Assam. When each loop has passed through the *rás*, the latter is moved forward towards the *cheri* occupying the place of No. 4, till the intersection comes through. A second *guri* is inserted between the *rás* and the intersection and the *cheri* taken out and replaced instead of the second *guri* behind the *rás*. Then a heavy bar, called *sutár gári* (সুতাৰ গাড়ি) in Lower, and *ág-tolthá* (আগ টোলতা) in Upper Assam, with narrow channels cut along its length and a couple of holes at right angles to each other through one of its ends, is brought forward, and the *guri* placed in one of the narrow channels.

The warp, continued.

29. Two heavy pegs have meanwhile been driven into the ground, and the *sutár gári* is held against these, while it is turned so as to bring more and more of the warp around it. Short pegs, called *khilá bári* (খিলাবাড়ি)

in Kámrúp and *kán bári* (কানবাড়ি) in Upper Assam, put through the hole at the end of the *sutár gári*, prevent the latter from turning back, which the steady pull now maintained on it from the other end of the warp held by another woman would otherwise bring about. The *rás* is gradually pushed on as the *sutár gári* is turned. In this part of the operation the thread continually breaks, and is as constantly mended. When nearly the whole of the warp has been wound round the *sutár gári*, two more pegs are fixed into the ground opposite those which support the *sutár gári*, and a *guri* (inserted in place of No. 1) is brought up by its ends against these pegs, and retained there owing to the tautness caused in the warp, by the winding up of the *sutár gári* with the *khilá bári*. At the same time another *guri*, is inserted in place of No. 2. Then a thin rod of bamboo (*phulkia*, ফুলকিয়া), a little longer and thinner than the *guri*, is pushed across the warp, one close to the *cheri* in place of No. 4, and one near that in place of No. 3. These *phulkias* are passed carefully above and below alternate threads of the warp, as errors may have occurred. The threads are so arranged that those which pass above one will go below the other *phulkia*, the intersection of course being between. The *cheris* are then drawn out and re-inserted in the place of the *phulkias* which are removed.

The warp, continued.

30. At this stage then the warp is stretched tight upon two parallel horizontal rods, each of which rests against a pair of perpendicular pegs driven firmly into the ground. On each side of the *rás* is a *cheri*, one where No. 4 and one where No. 3 had been. The *guri* in place of No. 2 is pressed close to the *guri* in place of No. 1, to make certain that none of the threads overlap each other. The threads round these two *guris* alternate, it must be remembered, according to the number of threads passed through the *karhani*. If four threads had been passed through, then we should have four side by side above the *guri* occupying the place of No. 1, and next to them four below, and *vice versâ* with reference to the *guri* in place of No. 2. If six threads had been put through the *karhani*, then they would occur six at a time above and below.

The *bas*.

31. The next operation is the manufacture of the *ba* (ৰ), or series of loops by which the threads are alternately raised and depressed to allow the shuttle to pass. These are made as follows.

The first upper *ba*.

32. A woman takes her seat behind the *guri* in place of No. 1 and sticks a *chereki* with a skein (*lecha*, লচি, or *lecha*, লেচা, or *bati*, বাটি) of brown cotton thread upon it into the ground to her right. The *cheris* are turned up edgewise so as to separate the threads of the warp as much as

possible. The *rás* is pulled towards the *cheri* in place of No. 3, and the end of the thread from the *chereki* being attached to a thin piece of bamboo, the latter is pushed through the interval between the intersection and *cheri* in place of No. 4 and also between the upper and lower threads of the warp. Clearly, therefore, the threads of the warp between the intersection and the *cheri* in place of No. 4 pass alternately above and below the thread from the *chereki*. The operator next takes up a single joint of bamboo (*ba-chunga*, ব-চুঙ্গা) about 1½ inches in diameter. A *phulkia* is placed lengthways against the top of the *chunga*, and the latter held so that it touches the warp and is at right angles to its length. The thread from the *chereki* is tied to the *phulkia*, where it touches the left-hand end of the *chunga*. Then a loop of the *chereki* thread is taken up between the first and second threads of the warp (sometimes between second and third, that a selvage may be formed). This loop is passed upwards on the inside of the *chunga* (next the operator), then under the *phulkia* and back over it, then under the *phulkia* and down the outside (furthest side from operator) of the *chunga*. Thus, a figure-of-eight loop is formed, the upper half being small and round the *phulkia*, the lower half being large and round the *chunga*. The continuation of the thread after the making of the loop of course runs down to the same spot from which it was taken, *viz.*, the space between first and second threads (or second and third, if there is a selvage). It is easy to see that by the formation of this first loop the first upper thread of the warp has been caught, and is held up against the *chunga*. By upper threads here are meant those which pass above the *cheri* in place of No. 4. Next, a loop of the brown thread is taken up between the second and third upper threads of the warp, and, the same process being repeated, the second thread of the warp comes to have a loop formed round it and to be taken up against the *chunga*; so on to the end. As, however, the *chunga* is much shorter than the width of the warp, a *guri* is pushed through it, and as the loops are formed, they are slipped off and the *chunga* pushed on to the right hand side. Here it is taken out altogether, and one *ba* has been made, held up by the *guri* and *phulkia* close together and supporting half the threads of the warp.

The second upper *ba*.

33. The threads of the warp, so taken up, pass over the *cheri* in place of No. 4 and under the *cheri* in place of No. 3, and those which had passed under the *cheri* in place of No. 4 are, of course, the upper threads on the side of the intersection nearest the operator. Upon these latter threads another *ba* is formed in precisely the same way as the one

above described. Thus, two *bas* have been made, supporting, by a series of loops, every thread in the warp.

The lower *bas*.

34. But these *bas* are only capable of pulling the threads in one direction. In order to pass the shuttle, the threads of the warp must be alternately raised and depressed. It is necessary, therefore, to make another pair of *bas* below. This is done by reversing the warp, bringing uppermost the side that was below and fixing it up again by the short pegs of the *sutár gári* as before. In this position the two *bas*, already made, hang down, but as they had been attached to the upper threads before, they hang from the lower ones now. It is necessary to bring them to the top, and a little manipulation of the *cheris* and *rás* produces the required effect, and one *ba* is seen to hang from what are now upper threads. Then the end of the thread from the *chereki* is again attached to a piece of bamboo, which, being used as a needle, is passed along between the upper and lower threads of the warp from right to left of the operator and through the loops of the *ba* hanging from the former. The end, on coming out, is fastened to a *phulkia* placed on a *chunga* and the manufacture of a third *ba* thus begun. When this is finished, it is clear that each one of half the threads of the warp is held by two loops—one belonging to the *ba* above and one to the *ba* below. Then, the fourth *ba* is similarly completed. Thus, each thread of the warp is held by two loops—one belonging to a *ba* above and one to a *ba* below; these loops also interlocking.

The loom.

35. The warp being now ready to be attached to the loom, it becomes necessary to describe this structure. The loom (*sal*, সাল) is usually erected under the eaves of one of the houses, or else, if the household is a large one, there are two or three or more looms under a separate shed. To form the loom, four thick posts (*tánt khutá*, তাঁত খুটা, or *sálar khutá*, সালৰ খুটা) are driven into the ground, so as to make a rectangle about 5′ 10″ × 2′ 6″. Two of these, those next the house when the loom is under the eaves, and 5 feet apart, are higher than the others. Each high post is connected with its corresponding low one by a bar (*sál bári*, সাল বাড়ি) about three feet long, resting on the tops of the posts. This supports a long bar, called the *chati bári* (চাটি বাড়ি), or *háldará bári* (সালধৰাবাৰি).

Fixing warp on loom.

36. When the *bas* are finished, the warp and its attachments are carried over to the loom, and the *sutár gári* is hung by loops to the outside of the two shorter posts. The *rás* meanwhile is enclosed in an apparatus, called *dahtáni* (দেহ টানি) in Kámrúp and *dropadi* (দ্রোপদি) in Upper

Assam, which consists of two bars about 6 feet long with a hollow channel in each and fastened by pegs (*nág bári*, নাক বাড়ি, or *nág-khilá*, নাক খিলা, or *bagulá bári*, বগুলা বাড়ি) at the extremities. The pegs are loosened, the *ras* placed upright in the hollow channels, and the two bars closed down and tied up tight. This *dahtáni* is suspended from the *chatibari* at the same level as that at which the *sutar gari* has been placed. Sometimes the *dahtani* hangs by single strings, but often a set of three or four small wooden rings (*ghila*, ঘিলা) about 2 inches in diameter carry cords arranged on the principle of the pulley, and support each end of the bars. Then the *guri* in place of No. 1 is fastened to a bar, called *káparar gári* (কাপড়ৰ গাড়ি) in Lower Assam and *gurar-tholtha* (গুড়ৰ টোলঠা) in Upper Assam, similar in all respects to the *sutar gari*, which is hung by loops to the two long posts. The *guri* is so fastened that, by turning the *káparar gári* and loosening the *sutár gári*, the cloth, when woven, can be wound round the former. The warp is kept extended between the *káparar gári* and *sutár gári* by means of *khilá-bári* (paragraph 29) about three feet long. These are inserted into the holes that pass through the ends of the two heavy bars, which are then turned in opposite directions till the warp is tight. The bars are fixed in this position by the *khilá-báris* being pushed through till they reach the ground. Of ccurse, in the beginning it is the *sutár gári* that is turned to tauten the warp. Two strings are then attached to the *guris* and *phulkias* of the lower *bas* and fastened to the free ends of two pieces of bamboo which act as pedals (*garka* গড়কা). Sometimes two heavy bars (*jilothi*, জিলঠি) are attached to the lower *bas* to give weight. They hang by three strings from the *guris* and *phulkias*, and are attached by a single string each to the pedals. These are connected by a pin through the extremities furthest from the *bas* to two pegs fixed in the earth just under the *sutár-bári*. The pedals can move up and down, revolving on this pin. The strings connecting them with the *bas* are fastened about 3 inches from the free extremities, so as to allow a space on which the feet of the weaver can rest.

Suspending the *bas*.

37. Suspended by the middle from the *cháti-bári*, and often gracefully and quaintly carved, are two (occasionally three) pieces of wood, about 9 inches long, called *náchani* (নাচনি), or the dancers, from the comparatively rapid motion in which they are kept while the operation of weaving is being carried on. These are hung by the middles at right angles to, and just above, the *bas*. The two extremities furthest from the operator are attached to one *ba* and the opposite end to the other *ba*. Thus, when one pedal, say the right, is

pressed, the pair of *bas* (upper and lower) furthest from the operator go down, the ends of the *náchanis* attached also go down, and the other *ba* is raised by the rising of the extremities of the *náchani* nearest the operator. By this neat and simple arrangement the alternate threads of the warp are raised and depressed.

The woof.

38. The shuttle (*máku*, মাকু) is then brought forward, as the operator takes her seat on a small bamboo frame (1′ 7″ high by 1′ 11″ long by 10″ wide) close to the *kápaṛar gári*. The shuttle is a small boat-like piece of wood pointed at both ends, and with a hollow (*khulá*, খুলা, lit., opening or hole) cut in the centre. The thread for the woof (paragraph 26) is wound round a hollow piece of bamboo or simply round a piece of iron like a knitting-needle. When the former is the case, the bit of the bamboo with the thread round it is slipped on a piece of wire which fits into a hole at one end and a notch at the other end of the hollow part of the shuttle. When the knitting, needle arrangement is used, the needle with the thread round it is simply laid in the hollow and kept in its place by a piece of wire across the opening of the notch. In either case the thread can run out freely as the shuttle is shot across the warp. Before the weaving is commenced, the warp is frequently smoothed with a brush (*kuchi*, কুচি) steeped in a glutinous substance made of boiled rice (*kochu*, কচু) and the leaves of certain plants. When finished, the material is washed as soon as possible, for, if kept unwashed too long, the sticky substance applied would affect the durability of the cloth. Everything is then ready, and the ordinary process of weaving can begin. The total cost of the whole apparatus required to turn raw cotton into cloth is Rs. 10-8.

Putál.

39. The edges of the cloth, when some weaving has been done, are kept apart by an apparatus called *putal* (পুতল). This consists, when the fabric is strong, of two rods of bamboo, crossed, each a little longer than the width of the warp. The free ends are furnished with little iron spikes, which stick into the cloth. The other ends are united by a piece of string, which allows them to remain a couple of feet apart. Two loops of string, one on each side of the point where the rods cross, pass over the rods and the string which unites them. When these loops are pushed apart, the warp is stretched tight. In the case of fine fabrics, the *putal* is a single piece of bamboo with sharp extremities, of the same length as the width of the cloth. Sometimes two of these are used parallel to each other when the material is unusually wide. A whelk shell (*shamu*, শামু) containing a rag

with a little mustard-oil usually hangs from the *dahtáni*. The rag is used for moistening the *ras*.

The Bhutia loom.

40. The Bhutia system of weaving involves a much simpler apparatus. It is probably the simplest form of weaving known. The warp consists of an endless band of threads about 8 inches to 1½ feet wide. When woven, each strip is about 12 or 14 feet long. The warp is formed by winding thread continuously round and round a pair of sticks placed as far from each other as half the intended length of the piece of cloth. The warp having been made, two pieces of wood, usually small boughs of trees with a fork at the free extremity, are fixed upright in the ground, and a rod having been passed through the band of threads forming the warp, the former is placed in the fork of the uprights. These forks are about 4 feet from the ground. At the side furthest from the operator, two wooden hooks are stuck in the ground as far apart as the uprights are, and about 2½ feet from them. Another rod, which has been passed through the middle of the warp, is placed in the hooks, and the operator (always a woman) takes her seat on the opposite side of the uprights. The warp is then caught and tied up in a split bamboo, to the ends of which are fastened a leather strap, which passes across the back of the weaver. At this stage the warp passes over three rods, the one on the uprights, the one at the hooks near the ground and the inner piece of the split bamboo. The operator sits on the ground, and leans back when she wishes to make the threads taut, and forward when she desires that they should be loose. A rod of bamboo, longer than the width of the warp, is then taken, and a series of loops formed connecting it with every alternate thread. This corresponds to the *ba* of the Assamese (paragraph 31). Next a stick, about 1½ inches thick, is passed carefully across the threads of the warp above the *ba* just made, in such a way that each thread that passed through a loop goes under the stick and every other thread goes over it. This may be called rod No. 1. Higher up still, that is, nearer the rod over the uprights, a thin stick is inserted in such a manner that all the threads form loops around it before passing on. This may be called rod No. 2. The place of the Assamese *ras* is properly not taken by any part of the Bhutia loom. But the threads of the woof are pushed together by a hard piece of polished wood, about 2½ feet long and 2¾ inches in width, broad along one edge and sharp along the other. The shuttle is simply a joint of bamboo, in which the spindle carrying the thread of the woof lies loose. Another joint of bamboo, filled with water, is always beside the weaver, that she may keep the spindle moist.

Bhutia weaving.

41. The actual process of weaving is as follows: The operators, seating herself, finds the warp in front of her, sloping up at an angle of about 60 degrees with the ground to the rod that passes over the uprights. The strap passes across her back and the split bamboo to which it is attached lies across her lap. Taking up the *ba* with her left hand, she pushes rod No. 1 up towards rod No. 2, holding the former between the finger and thumb of her right hand, and pushing the latter downwards with the other fingers. This latter operation has the effect of tightening the threads which do not pass through the loops of the *ba* and of loosening the others. The *ba* being raised in the left hand, a space is formed between the threads of the warp; the two rods (1 and 2) being let go, the bamboo with the spindle is shot across by the right hand. The hard piece of polished wood is then taken up, and the thread that has just gone across is pressed down with it, the sharp edge being of course applied. The *ba* is then let go, and the shuttle taken up, while with the right hand rod No. 1 is brought down to and pressed close to the *ba*, the operator at the same time leaning back. This has the effect of making a gap between alternate threads of the warp between the operator and the *ba*, this gap being as wide as rod No. 1 is thick. At this point all the threads which pass through the loops of the *ba* are below, and all the others above, and when the shuttle is shot across from the left, it leaves a thread above all those of the warp under which the previous woof had passed, and below all those above which the previous woof had passed. This second woof is then pressed into its place by the hard piece of polished wood already referred to. Then, the *ba* is again raised, and the operation continued. As soon as an appreciable amount of cloth is made, a piece of bamboo, just as long as the cloth is wide, with a sharp nail at each end, is fastened by its two extremities to the selvages to keep the cloth of proper width throughout.

Bhutia rate of work.

42. From experiment it would seem that in a day of eight hours an industrious woman could do about 2 feet in length, if the warp were $16\frac{3}{8}$ inches wide, and about 4 feet in length, if the piece were $7\frac{1}{2}$ inches wide. That is, a woman would take approximately three and a half days to do a square yard.

Miris' weaving.

43. The method adopted by the Miris is somewhat similar to that in vogue amongst the Bhutias. The thread having been rolled up into a number of balls, the warp is made with them thus: Two women stand opposite one another, each having fixed in front of her a horizontal rod sup-

ported on two uprights. One end of a ball of thread is made fast to the end of one of these rods, and the woman who tied the knot then flings the ball to her friend, who passes it round the rod at her feet and flings it back. This is continued till a sufficient amount of thread has been wound round the two rods. The threads on one of these rods are then firmly tied, and the warp rolled up around it. The rod with the warp around it is then fixed to a post, and a woman takes her seat with the other rod in her lap. To the ends of this rod is now attached a strap of deer skin, which passes behind the weaver's back, and is just long enough to enable her to tighten the warp by leaning back, and to loosen it by leaning forward. The weaving process is just the same as that described in paragraph 40. The resulting cloths are long and narrow and are stitched together by the sides, to make a broad piece, exactly as is done by the Bhutias.

Manipuri and Nága looms.

44. The ordinary Manipuri loom used for making the finer cloths is nearly the same as that used in Assam. The one with which coarser cloths are made is similar to that employed by the Bhutias. The Nága loom is identical with that used in Bhutan.

Weavers.

45. There are no regular weavers in Assam, unless the Jugis or Kátanis can be classed as such. Fabrics are made by the women of the household almost always for domestic consumption. Superfluous articles, found after their manufacture not to be required, are sold, but, generally speaking, there is no trade in home-made piece-goods.

Manipuri weavers.

46. In Manipur, however, the case is different. Colonel Johnstone's remarks on this subject are to the point:

> Almost every description of cotton cloth is made in the little principality, from fine muslins down to coarse durries or carpets. All classes of women weave, from the wives and daughters of the Mahárája down to the poorest in the country. Little girls begin to learn at a very early age, and soon attain to great skill. Amongst all but the highest classes, the women not only supply their families with cloth, but make for sale also. As a rule, coarse cloths are far cheaper than in British territory, but the finer descriptions are much dearer. The latter are generally made from English thread, which for the better fabrics has almost superseded that of native manufacture. Even for the better class of petticoats, English thread is now used. This doubles the price. The cheapness of Manipuri cloths is entirely due to the fact that every woman in the valley employs her spare time in making them instead of in idleness. The Nága tribes, who utilise their women for field work, are ceasing to manufacture cloth. They buy it instead from the Manipuris, who are now beginning to imitate the Nága tribal patterns. The Manipuri cloth manufacture is thus artificially kept up by the want of an occupation that pays better.

47. The following list is believed to include all the articles usually made of cotton in Assam :

Articles made.

1. *Churias*, or waistcloths.—These are generally unornamented, but occasionally coloured patterns are woven into the ends, called "*phaijom*" in Manipur.

2. *Chadars*, or sheets.—These are almost invariably quite plain, except when made of the finer kinds of cotton yarn. In this case they are sometimes as fine as muslins, and are only prepared by women of respectability for private use. These carefully woven fabrics are generally decorated with elaborately-worked patterns of flowers, fruit, and birds in coloured threads, sometimes of silk and sometimes of cotton. The embroidered ends are called *phuls*, and almost every woman has her own particular pattern.

3. *Borkapors.*—Large, coarsely-woven, heavy but very durable cloths, generally used by both sexes, much in the same way as a shawl is used in Europe. There are a large number of different kinds, and the names vary in different districts.

4. *Khanya kapors.*—A highly ornamented shawl, worn double and generally 21 feet × 4 feet. Usually very finely woven and elaborately adorned along the borders with graceful designs of flowers and creepers. Sometimes the whole of the front sheet of the *khanya* is tastefully decorated with flowery spots. The ornamentation is usually made either with silk or coloured thread, or with a mixture of silk and gold or silver.

5. *Chelengs.*—These are similar to the above, but are usually only 3 feet × 10 feet in size. They are finely woven, and ornamented in much the same way as the *khanya*, but seldom to the same extent.

6. *Gamochá.*—A species of towel or napkin, usually plain.

7. *Paridia kápor.*—An embroidered shawl, very finely made and most artistically ornamented. This article of clothing is made and worn only by the upper classes. It is the highest example of the art of weaving as known in Assam. A single *paridia kápor* will cost from Rs. 40 to Rs. 200, according to the fineness of the materials used and the nature of the decoration employed. The ornamenting thread is usually gold or silver twist, sometimes both, and the design, though generally confined to the borders, spreads sometimes over the whole article. Flowers and birds are the commonest patterns, but these consist sometimes of nothing but graceful curves arranged symmetrically along the borders. Occasionally, a *paridia kápor* is made by attaching to a centre-piece of very finely-woven muslin-like material, border pieces ornamented by the few Muhammadans who still retain a knowledge of the art of weaving with gold and silver thread.

8. *Riha.*—A species of scarf, used by women. It is worn about the waist and breast, being passed under the right arm and over the left shoulder. One of the ends is often thrown over the head to serve as a veil.

9. *Mekhla.*—A species of petticoat. It is really an elongated sack, open at both ends, and is adjusted over the breast by the lower classes, and round the waist by the higher, the otherd en reaching nearly to the ground.

10. *Muslins.*—Made at Laskarpur in South Sylhet and in Manipur.

11. *Thán.*—A thick kind of cloth woven by Jogis in Sylhet, and used in the cold weather as a covering at night.

12. *Khesh.*—A thick striped cloth made by Manipuris.

13. *Jharans.*—Made chiefly at jails.

14. *Mosquito curtains.*—Made in Sylhet.

15. *Fanek.*—A species of petticoat in many colours, made by the Manipuris.

16. *Darries,* or carpets.—Made in Manipur.

17. *Inaphi.*—A species of shawl worn by women, peculiar to Manipur.

18. *Ngoubong.*—A species of shawl worn by men in Manipur.

19. *Khangtobphi.*—A counterpane used in Manipur.

20. *Pagris,* or turbans.

21. *Kilts* or strips of black cloth 3′ × 1¼′, ornamented generally with rows of cowries. They are called *lohání* when plain, and *keshini* when ornamented. They are worn only by Nágas.

22. *Purses.*—Called *checha* and worn at the waist by Nágas. They are narrow strips of folded cloth, with two edges sewn together and one end open.

23. *Jángáli.*—A kind of waistband with fringes at both ends, worn by men in the Brahmaputra Valley.

24. *Gundu.*—A strip of cloth worn round the loins by Gáro men, dyed blue, with thick red and fine white stripes.

25. *Rekhing.*—Similar to above, but worn by Gáro women.

26. *Pári.*—A species of warm rug made by the Miris. It consists of tufts of raw cotton woven into a backing of stout cotton cloth.

Dyes used.

48. In the above, colours have been more than once mentioned. It must not be supposed from this that dyeing is common in Assam. As a rule, fabrics are not dyed. The plains people wear usually white cotton cloth or silk of the natural colours. But coloured borders are common and are worked for the most part with thread dyed either in Bengal or Europe, and imported into the province. This practice has been resorted to in late years as more convenient than home dyeing, and on account of the brighter colours of the imported thread. On the other hand, some of the hill tribes within and without Assam prepare their own dyes and have their cloth even woven into tartans, often very pretty. These colours are generally very permanent. The Singphos, Phakials, and Khámptis prepare the best tartans. The Gáros, though wearing only the minimum amount of cloth possible, like to have it striped in different colours, and dye the thread for it themselves. All dye-stuffs found or used in the province are believed to be included in the following list:

1. *Indigo* (*Indigofera tinctoria, Linn.*).—This well-known plant is believed not to be grown in the province, and is very rarely used. The usual substitute is No. 7, mentioned below.

2. *Madder*—(*1*) *Rubia cordifolia, Linn.*, (*2*) *Rubia Sikkimensis, Kurs.*, Assamese=*majathi*, Manipuri=*moyoom*, Angámi Nága=*chenhu*, Lhota Nága =*enhu*.—No. (*1*) is the *madder* usually exported. It is brought down in the

cold weather by the Himalayan hill tribes. No. (*2*) is the species most common in the central chain of the Assam Hills. It is used by the Manipuris and Nágas to give the brilliant red colour so characteristic of their cloths, hair decorations for spears, &c.

The Manipuri process has been thus described :—The cloth to be dyed must first be subjected to the process mentioned in the first half of § 31. Then take a quantity of the creeper known as *moyoom*, and bake over a slow fire until it is perfectly brittle ; next pound until it resembles flour, and mix ¾ of a seer of it with 8 quarts of water and boil, stirring it gently the while ; steep the cloth in 2 quarts of *koohee* water (§ 30) ; then put it into the pot, and boil thoroughly in the mixture of *moyoom* powder and water ; lastly wash in clean water and dry in the sun. Repeat the entire process if the cloth is found not to have taken the proper colour.

The Angámi Nága process is simpler. The root, cut into fragments, is simply boiled with the yarn, till the desired red colour is produced.

3. *Safflower* (*Carthamus tintorius, Linn.*), Assamese=*kusum*.—Used for imparting both a red and a yellow dye. The colour is called *golap machoo* (lit., rose colour) in Manipur, and is imparted in the following way : Two and half tolas of *kusum lei* to be washed clean, then placed in a *jharun* or other coarse cloth, and squeezed and pressed about in 2 quarts of water, until the water becomes discoloured. This water to be thrown away and the process repeated in fresh water. After the water has become tinted to the required degree, the cloth to be dyed, having been washed perfectly clean, is steeped in the dye solution and squeezed about until it has well taken the colour of the water. Now take the *kusum lei* out of the *jharun* and dry it thoroughly, then mix ¾ of a tolah of *khoojoom perah* (species of *acanthaceæ*) ashes with it, and mix together intimately by pounding in a pestle and mortar ; then take an earthen pot, perforate 3 or 4 holes, and close these holes with wisps of straw or pieces of rag (in the same way as is done with the ordinary 3-ghurrah filters), then sprinkle a layer of damp paddy husks in the pot ; over this put in the mixture of *kusum lei* and *khoojoom perah* ashes, and over this again sprinkle another layer of paddy husks, then gently and by degrees sprinkle 2½ pints of clean water into the pot, and let it drip through the holes into a clean vessel below. Take the cloth, and, after wringing it out, steep it thoroughly in this liquid dye solution, pressing and squeezing it about so that every part of it may become thoroughly saturated, then wring out the cloth, and hang it up to dry *in the shade*.

4. *Catechu* (*Acacia catechu, Willd.*), Assamese=*khoira, khoir*.—Imparts with lime or alum a dull red.

5. *Turmeric* (*Curcuma longa, Roxb.*), Assamese=*haldi*, Angámi Nága=*untha*.—This is the cultivated variety. The commonest wild variety is *Curcuma Aromatica Salisb.*, and is found everywhere. The round short rhizomes yield a valuable yellow dye. The Angámis cut them into short pieces, which are boiled with the yarn to be dyed. A green colour is produced in Manipur by the following process: Soak a seer of wild turmeric root (it must be fresh), then pound it into shreds and sprinkle as much water over it as it will absorb ; then squeeze out the juice into a shallow vessel, and into this dip a cloth that has quite recently been dyed blue, press and squeeze it about for 8 or 10 minutes, then let it steep in the juice, having covered it over with the pounded *haldi*, for 6 or 8 hours, then wash clean in fresh water, wring out

and steep thoroughly in a pint of *heibung* water (§ 43), then wring out and dry in the shade. If the cloth has not assumed the proper colour, repeat the process.

6. *Asugach*—(*1*) *Morinda augustifolia, Roxb.*, (*2*) *Morinda persicæfolia Ham.* Assamese=*asugach, asukat,* Phakial=*kchaitun,* Gáro=*chenung,* Nága=*ntan.*—Very commonly used all through the province, and occasionally cultivated around the homestead. The roots of these plants are cut into very small chips, and thrown either into cold or boiling water. The cold water process gives a very bright red, while the solution in boiling water gives a very pale red. The colour varies according to the greater or less care bestowed on the dyeing, and is said to be very permanent. Chips of the bark of *leteku* and leaves of the *bhoomrati* are boiled with the *asugach* as a mordant.

The following is the process adopted by the Phakials :—The thread having been steeped in mustard oil, or in oil obtained from a pig or elephant, is boiled for an hour or two, and then exposed in the sun to dry for 20 days. When thoroughly dry it is washed and boiled with wood ashes in water and put out in the sun to bleach. Roots of the *asugach* are then cut up and pounded. Water and wood ashes are added, and, the thread having been placed in the mixture, the whole is warmed over a fire. It is then allowed to stand for a day, after which the thread is taken out and exposed to the sun. The shade of red depends on the number of times the thread undergoes the last steeping process and subsequent exposure. The oftener this is repeated, the darker is the colour produced.

7. *Rum* (*Strobilanthes flaccidifolius, Rees*), Assamese=*rum,* Manipuri =*khum,* Phakial=*hom,* Angámi Nága=*sapro,* Lhota Nága=*chimohu,* Khámpti=*tonham* or *ton kham.*—The usual Assamese substitute for indigo. Occasionally cultivated, and very commonly used. The leaves are mashed up and then steeped with the cloth or thread in cold water. In the Sibságar district the plant is broken up and boiled with the cloth, which has been previously steeped in country liquor. If lac-dye is added to the solution, a handsome purple colour is produced, whilst if mixed with chips of the bark of *tepur* and the leaves of *bhoomrati* as a mordant, a green colour is the result.

The Phakial process is as follows :—The twigs and leaves, having been steeped in water, are left for four days, when the vegetable matter is removed. Lime is then thrown in to precipitate the dye, and the liquid is left exposed to the sun in an open vessel for several days, then it is stirred about well and left standing for one day, after which the water is thrown away. A solution of ashes in water and fermented rice beer is next added to the sediment, and into this mixture the thread or cloth is thrown. After being steeped, it is exposed to the sun. The oftener it is steeped and exposed, the darker is the colour produced. In order to fix the colour, the thread or cloth, after it has attained the desired shade of blue, is boiled in a decoction of the bark of *moragach* (§ 59). By the Angámi Nágas the leaves and twigs are soaked in water for four or five days, and then taken out and ashes put in. After the thread has been steeped in this mixture for three or four days, it is taken out and dried and then boiled.

The Manipuri process has been thus described :—Put as large a quantity of leaves of the *khum* plant into a pot as it will hold, and then fill it with water, and let stand until the leaves become partially decomposed ; then

wring out the leaves gently in the pot and throw them away; next put a chitak or two of shell-lime into the pot, and let stand for 24 hours,—this lime has the effect of precipitating all the organic matter in the water to the bottom of the pot apparently; then pour off the water gently, and scrape out the sediment,—this sediment is *khumbang*. In from 10 to 12 quarts of water mix one seer of *khumbang* and let stand for 2 or 3 hours; then mix 8 chitaks of shell-lime in the pot and let stand for 24 hours; then add a pint and a half of *heibung* water; stir up the mixture thoroughly and let stand for 24 hours; then add 2 quarts of water that uncooked rice has been washed in, stir up thoroughly and let stand for another 24 hours; now add 3 tolas of shell-lime and 2 quarts of *ootee* water (a lye prepared from plantain or other ashes); mix thoroughly and again let stand for 24 hours, when the dye ought to be ready for use. If it is not, then more of some of the above ingredients will have to be added to it, but only experience teaches what particular ingredients are not in sufficient quantity in the dye. Wash the cloth to be dyed perfectly clean and steep thoroughly in the vessel containing the dye; squeezing and pressing it about for 8 or 10 minutes; then wring out and wash with soap and water (if soap is not at hand, rice water, *i.e.*, water that uncooked rice has been washed in, to be used: this ought to be stale, that is, two or three days old). If it is found that the cloth has not taken the dye well, repeat the above process, and hang out to dry in the sun.

The Khámpti process is somewhat similar to the above: The tops of the plant are cut twice a year, in May and October, tied into bundles and immersed in a large earthen vessel containing water, where they are left to steep about 3 days in May and about 6 days in October. Then the vegetable matter is taken out and thrown away, and the liquid, after being thoroughly stirred up by means of a *khaloi* (a jug-shaped wooden basket in which fish are put when caught) is allowed to settle for the night. In the morning the liquid at the top is poured off, and the sediment put aside in an earthen vessel for use as required. In this state the dye (now called *nám-ham*, from *nám*=water, and *ham*=*rum*) can be retained for 6 months or so without deterioration. When required for use, a solution of ashes in water (*khahar pani*) is added in equal quantities to the *nam ham*, and into this is put small quantity of a mixture composed of almost equal parts of the following ingredients: (1) the juice of a small esculent plant called *jya hamkhia*, (2) juice expressed from the bark of the *bhat ghila* tree, (3) a fluid obtained by squeezing a number of *amruli* (*Cricula trifenestrata*) worms into pulp. The solution thus prepared is exposed to the sun, and the shade of the dye is tested from time to time by dipping in the finger nail, alterations being made in the quantity of the ingredients according to the depth of the colour desired. When the right shade is obtained, the thread or cloth is steeped in the liquid for half an hour, and then exposed to the sun. The oftener it is steeped and dried, the darker is the blue produced. To fix the colour, the dyed material is placed over a fire in a closed basket till quite hot. It is then allowed to cool and finally exposed to the sun. This method of fixing the colour is only adopted in the case of cloths highly valued by the Khámptis.

8. *Tepur* (*Garcinia xanthochymus, Hook. f.*), Assamese=*tepur*, Phakial=*mahola*.—A small indigenous tree in the forests of Assam, the bark of which is used by the Phakials in the Lakhimpur district for dyeing

a bright yellow. Chips of the bark, with the leaves of *bhoomrati* as a mordant, are boiled with the yarn.

9. *Bhoomrati* (*Symplocos spicata, Roxb.*), Assamese=*bhoomrati*, Phakial =*moit soom.*—A small tree indigenous in the forests of Assam. The leaves furnish a very valuable mordant largely used in the province.

10. *Leteku* (*Baccaurea sapida. Mull. Arg.*), Assamese=*leteku.*—A small tree common in the forests of the province. The bark is used as a mordant, chiefly with *asugach.*

11. *Hilika* (*Terminalia citrina, Roxb.*), Assamese=*hilika silika.*—A large deciduous forest tree. The bark is cut into chips and boiled with the yarn or cloth to impart a black colour.

12. *Madhuriam* (*Psidium guaiava, Raddi.*), Assamese=*madhuriam.*—The common guava-tree introduced into the province, and cultivated for its fruit. The bark is boiled with the bark of the *hilika*, the mango, and the *jámu* to give a black colour.

13. *Arnotto* (*Bixa orellana, Linn.*), Assamese=*jarat* or *jarad*, Phakial= *phong*, Manipuri=*U Rei Rom Pambi.*—A shrub introduced into the province and frequently cultivated in the gardens of villagers for the sake of its seed-pods and seed. The pulp which surrounds the seed gives a beautiful flesh colour. The seeds are pounded, and then boiled with the yarn to be dyed. With *bhoomrati* leaves as a mordant, a yellow dye is the result. Sometimes, the bark of the *silika* is added, when the yellow dye assumes a reddish tint. Colours produced by this dye stuff are not permanent.

The process in Manipur is as follows:—Eight tolahs of seed of the *U Rei Rom Pambi* tree to be tied in a *jharun* or other coarse cloth, and steeped in boiling water. When the water has cooled down sufficiently to admit of one's hands being dipped into it, squeeze and press the *U Rei Rom* seed about in the cloth until the water has become thoroughly coloured, *i.e.*, has extracted all the colouring matter out of the seed. Wash the cloth to be dyed perfectly clean, steep it in this water, pressing and moving it about, until it has well taken the colour of the water ; then take out and wash four or five times in clean water. Wring out and dry, thereafter pour a pint of *heibung* water over the cloth, and press it about so that every part of it may become thoroughly saturated. Then wring out and hang up in the shade to dry.

14. *Siris* (*Albizzia procera, Benth.*), Assamese=*siris*, Gáro=*Sissoo*, Bengali=*koroi.*—An indigenous forest tree common in Lower Assam. The bark is cut into small pieces and boiled. Pounded leaves and twigs of the *dágál* are then mixed with it, and the yarn is boiled in the mixture. The result is a madder brown.

15. *Jámu* (*Eugenia jambolana. Lam.*), Assamese=*jámu*, Gáro= *chambu.*—An indigenous forest tree, the bark of which is used with that of the *hilika* and *madhuriam* to give a black colour.—A slate brown colour is produced by a boiled solution of *jámu, madhuriam, silika,* and *rojhoomala* barks. The bark is also used with *májathi* to impart brilliancy to the red. It is largely used by the Assamese in dyeing fishing-nets.

16. Lemon trees (*Citrus medica, Linn.*).—In the Sibságar district the bark of the lemon and pomegranate trees are boiled with iron filings to dye yarn black.

17. Pomegranate tree (*Pumica granatum, Linn.*)—Used as indicated under § 16.

18. Mango (*Mangifera Indica, Linn.*).—Used as indicated under § 12.

19. *Dágál* (*Sarcochlamys pulcherrima, Gandich*), Gáro=*dágál*.—Used as indicated under § 14.

20. *Lakedema* (scientific name unknown).—The seeds of this plant are pounded and mixed with powdered rice and mustard oil (the proportion being 1 seer of seed to 1 chitak of rice and ½ chitak of oil). This mixture is then smeared upon and well rubbed into the yarn, upon which boiling water, sufficient to moisten it, is poured. The yarn is then dried, and this process is repeated about three times a day for seven days. The colour is fixed to some extent by smearing the yarn with a powder obtained by pounding the root of the *haldi* plant, and again moistening the yarn with boiling water. It is not quite clear whether this *haldi* powder is purely a mordant, or is partly a dye stuff. By this process a red colour is obtained.

21. *Raspat* (scientific name unknown).—This is a small shrub. The leaves and twigs are boiled in water with the yarn to be dyed. The result is a fleeting red dye.

22. *Paolikaet* (scientific name unknown).—This plant, when pounded and boiled with the yarn to be dyed, imparts to the latter a brown colour. The roots when powdered and boiled with the thread give a yellow colour, which is fast.

23. *Mithaam* (scientific name unknown).—A plant the bark of which is used with that of *silika* and *jamu* to produce a black.

24. *Rajhoomala* (scientific name unknown).—Use described under § 15.

25. *Lac dye* (*Coccus lacca*).—The red dye obtained by evaporation from the liquid in which stick lac has been washed.

26. *Leingang*.—A species of earth found everywhere in Manipur, and used for imparting a *khaki* colour. The dyeing process has been thus described: Wet a chitak of wild turmeric (*haldi*), and rinse out its colour into 1½ quart of water; then mix two tolahs of *leingang* in the water; add ¼ of a pint of fresh milk and then strain. Wash the cloth to be dyed thoroughly clean, and then steep it in this mixture; press and squeeze it about, and then let it soak for half an hour. Wring out and dry, and when dry steep it again in the mixture as above. Wring out and steep in ¾ of a pint of *heibung* water thoroughly; and wring out and dry in the shade.

27. *Tita-sappa* (*Michelia champaca, Linn.*), Assamese=*Titasapa*, Bengali =*champa*.—A large handsome tree with yellow sweetly-scented flowers. These, when boiled, are said to yield a yellow dye, which communicates also an agreeable perfume to the fabric.

28. *Wendlandia tinctoria, D.C.* (vernacular name unknown).—The bark is used as a mordant in dyeing by the Nágas and other hill tribes in the province.

29. *Napoo* (*Fibrauria Trotterii, Watt. M.S.*), Manipuri=*napo*.—The root is used by the Manipuris for dyeing yellow. Major Trotter describes the process thus: Five chitaks of dry root of the *napoo* tree to be washed clean and beaten into long shreds; then soak these in 2½ quarts of water for 15 or 20 minutes, when it will be found that the water has become of a yellow colour; this water to be put aside, as it will be required later on. Take out the pounded roots, and resteep in the same quantity of fresh water, and let stand for 24 hours. Then wash the cloth to be dyed clean, and thoroughly soak it in the first solution, and take out and repeat the process

in the second water, leaving the cloth to soak in it for about half an hour; then wring out and steep in half a pint of *heibung* water, pressing and moving it about in the vessel, so that every part of it may become thoroughly saturated with this water, then wring out and dry in the shade.

30. *Koohee* (*Quercus fenestrata*), Manipuri=*koohee*.—Used by the Manipuris for changing the blue dye of the *rum* into a black. The Manipuri process has been thus described: Add 8 or 10 tolas of *kumbang* to the pot containing the blue dye; stir up thoroughly and then mix 4 tolas of shell-lime in it. Take a cloth that has recently been dyed blue, and steep it in 2 pints of *koohee* water (very simply prepared, thus, fill a pot with the bark of the *koohee* tree, and add enough water to submerge it, let stand for 24 hours, and then pour off the water), and press and squeeze it about for 8 or 10 minutes, then wring out and dry in the sun. When dry, steep thoroughly in the pot containing the blue dye; wring out and dry in the sun. When dry, again steep it in 2 pints of *koohee* water, dry in the sun, and again steep it in the blue dye and dry in the sun. Keep on repeating this process until the cloth has taken the proper colour, then wash with clean, fresh water, and finally dry in the sun.

31. *Thoiding* (a species of *Labiatæ*), Manipuri=*thoiding*. The dye, which is black, is prepared as follows: A quantity of *thoiding* to be fried and mashed up into a paste: take 5 tolas of this paste and mix in 2 quarts of water, then after washing the cloth to be operated on perfectly clean, steep it in the mixture, pressing and moving it about for about 5 minutes, then take out and wash thoroughly in clean water and spread out in the sun till dry; then mix 5 tolas of *thoiding* paste with 2 quarts of lye prepared from the ashes of the *kairang* tree and steep the cloth in this mixture; when thoroughly steeped wring out and dry in the sun; when dry, again repeat this process. Now pound ¾ of a seer of dried young leaves of the *chingjagoo* (teak) tree, mix 8 quarts of water with it and boil, stirring gently the while; steep the cloth in 2 quarts of *koohee* water (this water is to be prepared as follows for this dye:—fill a pot ¾ full with *koohee* bark, and pour in enough water to submerge it, then put the pot on the fire till the water simmers, when it will be ready for use), and put into the pot and boil it thoroughly in the mixture of *chingjagoo* leaves and water, moving it in and out the while: then wash in clean water, and dry in the sun. If the cloth is found not to have taken the proper colour, then the entire process, as above, must be repeated.

32. *Kairang* (*Symplocos racemosa, Roxb., non A.D.C.*), Manipuri=*kairang*, Khási=*Lapongdong*.—A small tree, the twigs and bark of which are chiefly used as a mordant by the Manipuris and Khásis.

33. *Chingjagoo* (*Tectona grandis*), the teak tree.—Used as a mordant, as described under § 31.

34. *Boga poma* (*Chickrassia tabularis, Adr. Juss.*), Assamese=*Boga poma*.—A large tree the flowers of which yield a red and yellow dye.

35. *Borthekra* (*Garcinia, pedunculata Roxb.*), Assamese=*Borthekra*.

36. *Nahor* (*Mesua ferrea, Linn.*), Assamese=*Nahor*, Bengali=*nageswar*.—A middle-sized, dark green tree, the flowers of which are said to yield a mordant.

37. *Kena* (*Perilla ocimoides, Linn.*), Nága=*Kenia*.

38. *Dopatti* (*Cinnamomum Tamala, Nees*), Assamese=*dopatti*.—A moderate-sized, evergreen tree, the leaves of which are used in calico printing in combination with myrabolams.

39. *Kendu (Diospyros embryopteris, Pers.)* Assamese=*kendu*, Bengali=*gábo*.—An evergreen shrub, the half-ripe fruits of which, being steeped in water, are sometimes used in dyeing brown.

40. *Madar* (*Erythrina Indica, Linn.*), Cachari=*madar*.—A small tree wild in the Assam hills. The dried red flowers, on being boiled, yield a red dye.

41. *Khoikhu* (scientific name unknown), Mishmi=*khoikhu*.—The twigs of this plant are sometimes used by the Phakials intead of the *asugach*. It produces a dark red. The process is the same as that described under § 6.

42. *Thekera* (*Ixora acuminata, Roxb.*). Assamese=*thekera*.—Used as a mordant chiefly with *arnotto*.

43. *Heibung* (scientific name unknown), Manipuri=*heibung*.—A solution of the fruit is used constantly in Manipur dyeing, but its exact action is not as yet understood. Experiments seem to show that it serves to develop the colour of the safflower dye. The solution is easily prepared, *viz.*, by soaking a pound of the fruit, cut in slices, in a pint of water for 20 or 24 hours.

44. *Gangai* (*Mallotus phillippensis, Mull.*), Assamese=*gangai*.—A small tree from the fruit of which the dye is obtained. It gives a rich red colour, and does not require a mordant.

45. *Kering* (*Oroxylum Indicum, Benth.*), Garo=*kering*.—A small tree the bark and fruit of which are believed to be used as a mordant.

46. *Amluki* (*Phyllanthus Emblica, Linn.*), Assamese=*amluki*, Gáro=*ambari*, Khási=*sohmyrlain*.—A moderate-sized tree, the fruit of which with myrabolams and sulphate of iron, gives a black dye.

47. *Teteli* (*Tamarindus Indica, Linn.*), Assamese=*teteli*.—A large handsome tree, the flowers and fruit of which are used as an astringent in dyeing, especially with safflower. It acts the part of a mordant.

48. *Hulluch* (*Terminalia belerica, Roxb.*), Assamese=*hulluch*, Gáro=*chirorœ*, Bengali=*bahera*.—The fruit is one of those exported from India under the name of myrabolams, and is largely used in dyeing.

49. *Amari* (*Terminalia tomentosa, Roxb.*), Assamese=*amári*.—The bark cut up into small pieces and boiled for six or eight hours gives a brown dye. It gives a black dye with iron.

50. *Atkuri* (*Wrightia tomentosa, Roem* and *Scheult.*), Assamese=*atkuri*.—A small deciduous tree.

51. *Sakubi* (scientific name unknown), Khási=*sakubi*.—The colour is red and is produced as follows: Take half a seer of lac and boil with water. Then put in leaves of the *sakubi*, and when both are dissolved immerse the yarn. When well steeped, take out and dry in the sun. Repeat the process three times, and the yarn will be dyed a good red.

52. *Nei* (scientific name unknown), Khási=*nei*.—Imparts a good red dye if the following process is used: Pound the seed of the *nei* plant to a powder, and place it with the uncoloured yarn in a vessel. Fill the vessel with hot water, and then take out the yarn and dry in the sun. Repeat this process daily for a week. Then pound well the bark of the *lapangdong* tree and the bark of the root of the *larnong*, and mix the powders well together, one pound of each, in a vessel of hot water. Then put in the yarn, and after letting it steep take it out and dry in the sun till it becomes hard, wash then with hot water and repeat the process.

53. *Syboo* (scientific name unknown), Khási=*syboo*.—If the yarn be soaked for a day in a solution, three days old, of washed leaves of the *syboo* and wood ashes, it will be dyed black.

54. *Larnong* (*Morinda tinctoria*, *Roxb*), Khási=*larnong*.—The bark of the root is used to dye red as mentioned in § 52.

55. Jack-tree (*Artocarpus integrifolia*, *Linn.*), Gáro=*thibrong*, Bengali=*kathal*, Assamese=*konthal*.—Imparts a pale yellow when the wood or its saw-dust is used.

56. *Tejju* (scientific name unknown), Angámi Nága=*tejju*.—Strips of the bark are boiled in water for twelve hours or more till the mixture takes a dark red colour. Earth of the kind usually found in the terraces under rice cultivation is added, and the cloth or thread to be dyed thoroughly soaked in the solution. The result is a black dye.

57. *Bharali* (scientific name unknown).—A middle-sized forest tree. The yarn is first boiled with the leaves of the tree and then dyed with *silika* if black is wanted, and with lac if red is desired. If yellow is required, madder is used. *Teteli* (§ 47) is employed if no *bharali* be available.

58. *Bholaguti* (*Semecarpas cardium*, *Roxb.*), Assamese=*bholaguti*, Gáro =*bawaræ*.—The black acrid juice of the nuts is used largely to mark cotton garments. The colour is improved, prevented from running, and fixed by a mixture of quicklime and water.

59. *Moragach* (scientific name unknown), Assamese=*moragach*.—The bark is used as described under § 7.

60. *Dinghjangmat* (*Berberis Nepalensis*, *Spreng.*), Khási=*dinghjangmat*. —A shrub found in the Khási and Nága Hills, generally at altitudes above 5,000 feet. Used to a small extent as a yellow dye, chiefly by the Bhutias and Nágas.

61. *Palás* (*Bhutea frondosa*), Bengali=*palás*.—A small distorted tree with bright orange flowers. These, when dry, are used as a yellow dye, which is obtained by steeping or boiling in water.

62. *Purai* (*Basella Rubra*, *Willd.*), Assamese=*purai* or *pue*.—The seed of the *pue sák*, which is used as a vegetable, gives a red colour. Red ink is sometimes prepared from it. Owing, however, to the colour not being permanent, this dye stuff is not much used.

63. *Urohi Mahorpat* (*Vigna Catiang*, *Endle*).—Said to yield a green dye. The process has been thus described: Place a quantity of the leaves of the *rum* (§7) in an earthen vessel full of water, and, having tied up the mouth, allow the vessel to stand for three or four days, or until the leaves rot. Then take out the rotten leaves, squeezing all juice out of them in so doing, and shake the liquid left behind well for some time. Then tie up the vessel once more, and let it stand for the night. Next morning pour off any watery fluid that may be found, and add to it $\frac{1}{5}$th the quantity of ash-water (called *kharoni* in Assamese, and made by filtering water through wood ashes), $\frac{1}{10}$th the quantity of native liquor, and $\frac{1}{20}$th the quantity of the juice of the *thekera* (§42). Then place the mixture in the sun for three consecutive days, after which the material to be dyed should be dipped into the liquid, and squeezed out and sun-dried, this process being repeated for three days. Then place in a mortar *urohi* leaves 4 parts, *turmeric* 1 part, and *thekera* leaves 2 parts. Crush the whole well, and, after rubbing the pulp so formed well into the cloth dyed as above with the *rum*, leave the whole cloth and pulp to steep for the night. Next morning squeeze the juice out of the material, and dry in the sun. The process should be repeated till the desired shade of green has been obtained. The leaves of the plum-tree

are said to answer as well as those of the *urohi mahorpat*. There is another method of producing the dye, in which lime-water is used instead of ash-water, the rest of the process being identical with that described above.

64. *Bael* (*Ægle Marmelos, Correa.*), Bengali=*bael.*—A yellow dye is obtained from the rind of the fruit.

65. *Kámránga* (*Averrhoa carambola, Linn.*), Bengali=*kámránga.*—The unripe fruit is used as a mordant, and also to give brilliance to the colour.

66. *Barún* (*Crataeva religiosa, Forst.*), Bengali=*barún.*—The rind of the fruit is used as a mordant.

67. *Sephálikā* (*Nyctanthes Arbor-tristis, Linn.*), Bengali=*Sinli*, Hindi *Harsinghar.*—The corolla tubes are orange coloured, and give a beautiful but fleeting orange dye.

Inter-district trade.

49. The trade in cotton is partly inter-district and partly provincial. The registration of the former is carried on at a few police stations, but no attempts have as yet been made to summarise or elucidate the figures. The registration is really too partial to throw much light on the character of the trade. It is known, however, that the plains districts purchase largely for local consumption at the marts at the foot of the hills. The Gáro Hills supply Goálpára and parts of Sylhet. The Jaintia and lower Khási Hills meet the wants of South Kámrúp and North Sylhet. Jaintia Hills cotton also goes down to Nowgong and parts of Sylhet. Darrang is supplied, like the greater part of Nowgong itself, by the Mikirs. North Cachar cotton goes into Nowgong by the Doyang and Kopili, and also into the plains of Cachar. The Nága Hills export to Sibságar and parts of Lakhimpur. In all these transactions human beings are the beasts of burden, except when boats are used. Pack-bullocks are unknown, and ponies are not used for the purpose. The hillmen carry down the fibre, nearly always uncleaned, in conical bamboo baskets, which they support by a plaited cane strap across the forehead, partly on their heads and partly on their shoulders. These baskets are packed as follows by the Mikirs: The basket having been lined with leaves of the *tara* plant (found everywhere) is placed upright in a hole in the ground. One man fills it with cotton, while another treads down the fibre. When filled, some leaves of the *tara* plant are placed along the top, and the whole firmly bound down with strips of bark or cane. A basket of cotton is called *dang* by the Mikirs, and weighs usually half a maund. The plains people carry cotton in small bales suspended to the ends of a stout bamboo, which is borne on the shoulder. Boats are used when the trade route coincides with a river, and considerable quantities are floated down to the more important riverine marts. Wheeled carriage is absolutely unknown, and long strings of camels, laden with heavy, half-compressed bales, such as are so frequently met with in the cotton districts of Upper India, are never seen in Assam.

External trade.

50. The export trade by boat is registered at Dhubri for the Brahmaputra, and at Bhairab Bázár for the Surma Valley. The steamer traffic, which is inconsiderable, is known from the returns furnished by the steamer companies. The following table gives details of the exports both by boat and steamer for the last five years :

	Maunds.	Cwt.
1881	20,027	14,713·64
1882	18,464	13,565·31
1883	14,199	10,431·86
1884	17,071	12,541·87
1885	26,277	19,305·45

Unregistered exports.

51. The above figures show the trade past the two registering stations. But a large quantity of Gáro Hills cotton does not pass either. It goes to marts which lie either below Dhubri on the river, or opposite the Bengal bank, and is therefore never registered at all. The Deputy Commissioner, Gáro Hills, estimates that the equivalent of 28,571 cwt. cleaned cotton was exported from his district in 1884-85. Of this, he considers that 8,828 cwt. alone was registered at Dhubri. Therefore 19,743 cwt. would appear to have left the district by more direct routes for Bengal.

Proportion of cleaned to uncleaned exported.

52. The returns from which the figures of paragraph 50 are obtained do not distinguish between the cleaned and uncleaned fibre. It is known, however, that most of the cotton from Assam goes down to Calcutta without being ginned. If we assume the proportion to be about 3 to 1, we shall probably be sufficiently near the truth.

Imports.

53. The indigenous supply of cotton is not enough for the wants of the people. Not only is European yarn regularly imported in considerable quantities, but there is a large demand also for European piece-goods. The following table gives details for the last five years, the figures for yarn representing cwt. and those for piece-goods money :

	Imported manufactured cotton.			
	European yarn in cwt.	Indian yarn in cwt.	European piece-goods in Rs.	Indian piece-goods in Rs.
1881	3,925	...	43,07,602	45,630
1882	4,868	17	46,63,274	19,100
1883	4,528	28	53,56,010	26,064
1884	4,088	101	47,33,477	68,372
1885	9,467	169	82,81,020	61,040

Total outturn and local consumption.

54. From the data above given, an attempt can be made to estimate the total outturn of the province and the amount retained for local consumption in 1884-85. From paragraph 7 the area is seen to be estimated at 38,815 acres. The average yield is believed to exceed 150 lbs. of cleaned cotton to the acre (paragraph 16). This gives a total outturn of 51,984 cwt. The registered export of cleaned and uncleaned cotton amounted in the year ending 31st March 1885 to 19,305 cwt. Taking the proportion as 3 to 1 (paragraph 52), we have 4,826 cwt. of cleaned and 14,479 cwt. of uncleaned fibre. The latter is equivalent at 5 : 2 (paragraph 17) to 5,791 cwt. of cleaned cotton. Add the unregistered export of paragraph 51, *viz.*, 19,743 cwt. The total export may then be reckoned as equivalent to 30,360 cwt. of pure fibre. Deducting this from the total outturn, we have a local consumption of indigenous cotton, amounting in 1884-85 to 21,624 cwt.

Value of total consumption.

55. Cleaned cotton sold at from Rs. 18 to Rs. 20 a maund in the province. Taking Rs. 19 as the average, we have for the total value of the indigenous cotton consumed Rs. 5,61,165. Besides this, however, the River-borne Trade Report shows the following imports :

	Rs.
Raw cotton, worth	4,209
European and Indian yarn, worth ...	5,33,885
European piece-goods, worth ...	82,81,020
Indian piece-goods, worth	61,040
Total	88,80,154

Adding this total to the value of the indigenous cotton, we have Rs. 94,41,319 as the sum which the people of Assam paid in 1884-85 for their cotton goods. This is Re. 1-15-3 per head of the population. In the Punjab, the same calculation gives Rs. 2-12 per head.

Prospects of the trade.

56. It will be apparent from the preceding that, though as yet only an inconsiderable portion of the cotton produced in Assam is exported, there is every probability of a future before the cotton trade of the province. Up to date there would seem to have been little or no capital expended. The export has been managed entirely by Marwari traders, who are satisfied with small transactions and comparatively small profits. The cotton marts are insignificant villages at the foot of the hills, or at suitable points at the junctions of rivers. Ginning machinery was until lately unknown, and by far the larger proportion of the fibre of the province goes down to Calcutta retaining the seed.

Cleaning with native gin.

57. This is, perhaps, the most curious anomaly in connection with the trade. It evidently does not pay to gin cotton in Assam. Two reasons are usually alleged. One is that labour is here far too dear. The other is that the seed, though of no value, or nearly no value, here, is saleable in Calcutta. No doubt these are the main reasons affecting the result, but the fact cannot for a moment be doubted that, if the ordinary gin is used, it does not pay to clean cotton before exporting it.

Cleaning with English gin.

58. The reverse has, however, been shown to be the case when machinery is employed. At the present moment there are two English gins at work in the province. One is at Tura in the Gáro Hills, the centre of the trade in Gáro Hills cotton. The other is at Doboka, in Nowgong, where the Jamuna is turned south-west by the western spurs of the Mikir Hills. This gin is therefore admirably placed for intercepting Mikir Hills cotton. At Tura uncleaned cotton was selling last year at Rs. 4-8 per maund, and cleaned cotton at Rs. 14 per maund. The machine (one of Burgess & Co.'s Emery's Patent 13-saw hand cotton gins) was found capable, in a working day of eight hours, of turning out one maund of cleaned cotton. The daily profit is shown in the following statement:

EXPENDITURE.

	Rs.	a.	p.
Two maunds uncleaned cotton, at Rs. 4-8 ...	9	0	0
Wages of three men, at 3 annas each	0	9	0
Oil, &c.	0	1	0
Total	9	10	0

RECEIPTS.

Value of 1 maund cleaned cotton, at Rs. 14 ...	14	0	0
Ditto seed, at annas 10	0	10	0
Total	14	10	0
Daily profit	5	0	0

Profit of English gin.

59. The above figures are not an estimate. They represent what actually occurred. Some of the machine-ginned cotton realised Rs. 18 a maund in Calcutta. The cost of carriage from Tura, *plus* broker's charges, amounts to Rs. 2-4-0 per maund. Consequently, the value at Tura should have been Rs. 15-12-0. If this price had been realised, the profits would have amounted to Rs. 6-12-0 per diem. The

machine landed at Tura cost Rs. 420. Taking the profits at the lower figure given above, it is clear that the initial cost would be recovered in a little over three months.

English gin injures the cotton.

60. It would seem, however, that the action of the saws is injurious to the fibre. Two bundles of Gáro Hills cotton were forwarded to an expert for report. Each bundle consisted of two seers of cleaned cotton. One (marked A) contained fibre cleaned by the ordinary hand gin, the other (marked B) was the produce of the patent gin, but these facts were not stated on the bundles or in the letter which accompanied them. The following is the report received, dated Calcutta, 18th July 1885 :

The two samples, marked A and B, represent a class of cotton known here as "Assam cotton." The difference between the two is very distinct :

A is "hand-ginned."

B is decidedly "machine-ginned."

With respect to A, the class is fully up to a good delivery, being entirely free from seed and stain, though containing, perhaps, a little too much "discolour," valued to-day at about Rs. 21 per maund.

B is of a class not desirable. The cleaning process having done away, to a considerable extent, the particular feature of the "Rough Fine" cotton, valued to-day at about Rs. 16 per maund.

A and B are descriptions of "Rough Fine." This class of cotton is principally consumed in Saxony by the wool manufacturers in the form of mixing ; the "rougher" the better.

A, quoted at Rs. 21, is about 5 to 6 per cent. above its average value.

Profit nevertheless.

61. This report is distinctly unfavourable to the English machine, but it does not prove that it is unprofitable. It must be remembered that the outturn could probably be increased were the machine worked with greater speed. So far, it has not been utilised to its full extent, as the workmen were new to it, and it was feared that, if pressed, they would injure the apparatus. Taking, however, the estimate of Calcutta value given in the above report, cotton cleaned by the Emery gin would be worth Rs. 13-12-0 at Tura. This would give a daily profit of Rs. 4-12-0, and would enable a purchaser to recoup himself for the original cost in less than four months, *i.e.*, in his first season's operations.

Doboka.

62. At Doboka, the price of cotton (cleaned and uncleaned) is lower than at Tura, and wages would be higher. Seed, again, would not sell at all at the former place, so that it may be taken as proved that an English machine would probably not make as much profit there as at Tura. But it has been shown that, taking the most unfavourable view of the facts, a profit of 100 per cent. can be made in four months at

Tura. This being so, there is room for the profit to decrease considerably before the stage is reached at which the purchase of a machine would become unremunerative.

Conditions of profit.

63. It is of course essential, if ginning is to be worked profitably, that the machine should be placed at a spot where cotton can be obtained in abundance, and where means for readily exporting the cleaned fibre are available. Where the first condition exists, the second is almost certain to be found. It would seem, then, that where cotton is to be had in sufficient quantity, an English machine must pay well. There is no part of the province fairly well inhabited where the small amount of labour required could not be obtained for at least 8 annas per man per day. There is no cotton mart in Assam where the cleaned fibre costs less than Rs. 14, or the uncleaned commodity more than Rs. 5 a maund (as a matter of fact, if uncleaned cotton cost Rs. 5 a maund, cleaned could not be sold at Rs. 14. It would be certain to fetch Rs. 19 or Rs. 20). However, let us omit the seed and take these figures (the most unfavourable possible), and work out the profit on a machine such as is mentioned in paragraph 58:

EXPENDITURE.

	Rs.	a.	p.
Two maunds uncleaned cotton, @ Rs. 5 ...	10	0	0
Three coolies, @ annas 8	1	8	0
Oil, &c.	0	1	0
Total	11	9	0

RECEIPTS.

One maund cleaned cotton, @ Rs. 14	14	0	0
Profit	2	7	0

Therefore, to recover his original expenditure, the owner would have to work his machine 151 days, or, in other words, to make sure of at least 302 maunds of uncleaned cotton. Therefore, under the most unfavourable circumstances possible, it may be laid down that an English ginning machine, such as has been described, would repay its cost in less than six months in any town in Assam, provided the owner could obtain 302 maunds of uncleaned cotton within that time.

THREE MANUFACTURES OF ASSAM.

By H. Z. DARRAH, Esq., *I.C.S.*, 1885.

This is the first* of a series of annual notes which it is proposed to publish with reference to manufactures in Assam. Three subjects only have been taken up on this occasion, as it was thought better to deal fairly fully with a small number than to put together cursory remarks on many. In succeeding years it is hoped that the various industries of the province will be successively taken up, and a nucleus thus formed for an exhaustive report on the handicrafts of Assam.

The subjects dealt with this year are—

I.—The brass work of the Morias.
II.—The gold enamelling of Jorhát.
III.—Iron smelting in the Khási Hills.

2. It must not be supposed that the following notes exhaust the topics they deal with. Very far from it. They are intended merely to form a basis for a more complete enquiry hereafter. They are believed to afford the information available up to date on each subject dealt with. When a sufficient amount of additional facts have been collected, the notes will be re-written.

I.—THE BRASS WORK OF THE MORIAS.

3. Brass utensils are generally made in Assam by a particular caste, known by the generic name of Moria. Morias are Muhammadans of low caste, with a history of their own. It would seem that they are the relics of the unsuccessful Musalman invasion of 1510, the survivors of which were reduced to captivity, and permitted finally to embrace the calling of braziers.

4. The work is done in several parts of the province, but the following information was mainly collected in the district of Darrang. There are but two seats of the manufacture in that district. These are Moriagaon, in mauza Binburi of the Gabru tahsil, and Moriagaon, on the Boreli river, about 8 miles from Tezpur. Moriagaon simply means "the village of Morias."

5. Morias never cast brass into the shapes of the vessels they manufacture. They always use sheet brass about one-sixteenth

* This was for the year 1884-85, and was followed by the author's note on the "Eri Silk in Assam," 1890, which is reprinted in this volume (*vide* page 77).

of an inch in thickness, and join pieces of it together to produce the desired shape, in the manner described below. The instruments they use are the following; they are made generally by local blacksmiths:

1. *Belmuri* (বেলমুরি), large anvil.—This is a block of iron, shaped like a short, thick, flat-topped tent-peg. The diameter of the top is about one-third the whole length. The pointed extremity is driven through a hole in a small board and into the ground below. The board keeps the anvil from being driven too far into the ground by the hammering it receives during work.

2. *Satuli* (চাতুলি), small anvil.—This is a bar of iron, shaped exactly like a tent-peg, with a flattish head. The pointed end is driven into the ground, and the article to be manufactured beaten into shape on the top.

3. *Dheka* (ধেকা), double anvil.—This is shaped like the head of a hammer, except that it is thinner, longer, and has one end pointed. The part which in a hammer is prolonged over the wood of the handle consists in the *dheka* of a point, which is driven into the ground or a piece of wood when the implement is being used.

4. *Harugora* (সৰগৰা), hammer.—It is medium-sized, with one straight and round, one curved and chisel-shaped extremity. The handle passes through a hole in the head.

5. *Patmora* (পাতমৰা), hammer.—Shaped like a pick-axe, but with chisel-shaped ends.

6. *Borhaturi* (বৰহাতুৰি), large hammer.—Shaped like the *harugora*, but very much larger and heavier. The flat extremity is hexagonal in shape. It is only employed in heavy work.

7. *Golmora* (গলমৰা), hammer.—The head is very long and thin, but the general shape is the same as that of the *harugora*. It is used for hammering the interior of utensils into which ordinary hammers cannot go.

8. *Mathoni* (মাঠনি).—A small thick-set hammer, with one end shorter than the other.

9. *Sorah* (সৰাহ), pincers.—There are two kinds, one like an ordinary pair of English blacksmith's pincers, and one like a pair of sugar tongs.

10. *Kati* (কাটি).—Scissors roughly made, and with blunt points, but strong enough to cut sheet brass.

11. *Bhati* (ভাটি), bellows.—These are made of goat's skin, with the hair outside. They are funnel-shaped, and the point of the funnel is connected by means of a small bamboo pipe with a narrow underground channel communicating with the bottom of the furnace. The upper part terminates in a wide mouth, formed by two slips of bamboo about a foot long. A loop of string attached to the centre of each connects the two slips of bamboo. The operator works the bellows with his left hand, adjusting the fire with a rod held in his right. The loop passes over his hand, and as he raises it, with the slips of bamboo apart, air fills the bellows; the hand is then closed, thereby bringing the two slips together, and pressed down, thereby forcing the air into the furnace.

12. *Aphuri* (আফুৰি), furnace.—This is simply a hollow in the floor of the hut.

13. *Bagi* (বাগি), chisels.—These are small instruments with the extremities slightly bent, and used for cutting rings and other ornamental devices on the finished brass utensils.

14. *Mohi* (মহি), crucible.—A small gourd-shaped vessel of baked clay, about 4 inches in diameter. When in use, the mouth is covered by a little cake of clay called *mola* (মলা).

15. *Pojal* (পজাল), mould.—This is a piece of baked clay, exactly like a brick, with hollows of various shapes on the surface.

16. *Naora* (নাওৰা), a wooden trough containing water.—It usually stands close to the *aphuri*.

17. *O* (ও), file.—Triangular and square ones are in use. The latter are made by the Morias themselves, and are very rough.

18. *Nogora* (নগৰা).—A ring made of grass and used in breaking up *pán* as described below.

19. *Kund* (কুন্দ).—This is a species of lathe, consisting of a rod of wood inserted at one end into one of the posts of the house and at the other into a peg (*borisila*, বৰিচিল) driven into the ground. Articles like *lotas*, which are ornamented by rings cut into the brass, are fixed on the rod with lac and turned.

6. *Pán* is the material used in joining the sheet brass, where a junction is necessary. It is made by melting together three parts of sheet brass and one part of solder (*hetu*, হেতু). The result is a brittle compound, which is broken up into fragments on an anvil, inside the *nagora*. The *pán* will not flatten out when struck by a hammer; it breaks up. In melting the *pán* the crucible is more than once taken out of the fire, and rolled in a heap of rice husks (*thu*). This is said to remove all danger of the clay breaking. Goats' fat is put into the mould before the melted *pán* is poured into it. When it becomes necessary to join the two edges of a sheet of brass, nicks are cut in one edge, and the other edge fitted into these, and the two beaten flat. Then a rough paste is made of some broken-up *pán* (or *páin*, as it is sometimes called) and borax (*hoyágá*, হোয়াগা or *huyogá*, হুয়গা), which is smeared over the joining. The junction is then heated, the *pán* melts, and the union is cemented. The processes of manufacture are exceedingly simple, and consist merely of beating the brass into the shape required or of uniting portions of it as described above. Sheet brass is bought from Marwari merchants at prices varying from Rs. 30 to Rs. 40 per maund. It all comes from Europe. Old brass is also sometimes obtained by exchanging new vessels for it The usual rate is two seers of old brass for one seer of the new article. The general price of new utensils is Re. 1-8 per seer. Charcoal is the fuel always used. The Morias in outlying tracts, such as the two villages in Darrang, make it themselves from drift timber.

7. The articles usually made are the following:

1. *Tou* (তৌ).—A basin-shaped vessel, formed of four pieces of brass, and used for cooking rice.

2. *Ghagori* (ঘাগৰি).—A decanter-shaped vessel, with an ornamented top, formed of eight pieces of brass, and used for keeping and carrying water in.

3. *Berhá* (বেৰহা).—A tripod consisting of a ring about a foot in diameter, supported on three hollow cone-shaped legs, the interiors of which are filled with pieces of broken brass, to make a jingle. The tripod stands about 14 inches high, and is used to support the flat dish out of which an Assamese usually eats his rice.

4. *Soriya* (চৰিয়া).—A large heavy basin, with an ornamented rim. Used for cooking.

5. *Heta* (হেতা).—A brass spoon with a handle thin towards the bowl, and thick towards the opposite extremity.

6. *Koloh* (কলহ).—This is exactly like a *ghagori*, except that it is provided with a rim of brass round the bottom to enable it to be placed upright on the ground. The *ghagori* has no such rim. The top or mouth of the *koloh* may be ornamented or plain.

7. *Hoari* (সৱাই).—A brass tray, circular in shape, supported on a highly ornamented brass pedestal. It is used by the wealthier classes as a stand for *pán-supári*. It is about 18 inches high.

8. *Lota* (লোটা).—A small vessel with a trumpet shaped mouth, used for holding water and as a drinking glass.

9. *Chaki* (চাকি).—A lamp, or rather brass stand, with an open cup-shaped vessel at the top, which is used for holding oil. The wicks are simply threads of cotton laid across the ends, projecting beyond the edges of the cup.

II.—The Gold Enamelling of Jorhat.

8. Enamelling on gold is done mainly at Jorhát in the Sibságar district. The artificers are Sunars, and possess a fair amount of skill. As, however, they work almost entirely for the native trade, the articles produced lack the finish to be seen in ornaments manufactured for European customers. There are many Sunars in Jorhát, who work in nothing but gold. These do not enamel, but those who enamel also work in gold. The different families engaged in the enamelling trade are believed at present to number 38. The enamel (*mina*, মিনা) is usually of three kinds, a dark blue, dark green, and white, but red and yellow are also sometimes used. It is bought in blocks, exactly like glass slag in appearance, from Marwari merchants. The price varies from 8 annas to Rs. 2 a tola. It comes from Calcutta.

9. The tools used in the manufacture are small hammers, files, pincers, and anvils. They are said to be of English manufacture. and to come from Calcutta. Some, however, are made in Sylhet The only tools peculiar to the enamelling process are the following :

1. *Hola* (সলা).—A small instrument like a knitting-needle, flattened at one end, used for putting the enamel into the interstices of the ornament to be operated on.

2. *Ghor* (ঘৰ).—A half cylinder of baked clay about 3 or 4 inches long, closed at one end, and perforated with holes. The ornament is heated under this in the fire to fix the enamel.

3. *Khán* (খান).—A file made in the following way: A stone, called *jaron* (জাৰন) (like a heavy sandstone in appearance) is obtained from the neighbourhood of Gauháti. It is usually brought to Jorhát by *Telis*, or oil merchants, and sells at 4 annas to 8 annas a seer. This is pounded to powder, and then a piece of lac is heated and pressed into the powder, some of which adheres. The lac is heated again, and takes up more powder, and so on till the whole has become a close compound of lac and *járon* powder. The mass so formed is pressed on the end of a piece of bamboo, and made roughly into a square column. This forms a very fine grained file for smoothing the surface of the gold.

10. The finished ornament usually shows narrow threads of gold arranged in fanciful patterns in the body of the enamel. These are formed of wire, and are laid on before the enamel. When the wires have all been put on, and the pattern which is to appear through the enamel formed upon the ornament in process of completion, some powdered enamel of the desired colour is mixed with water in a shell (*khamuk*, সামুক), and the coarse paste so formed applied by means of the *hola* to the spaces between the gold wires. These having been filled up, the ornament is fixed by a hole, purposely left in it, to the top of a nail, standing up out of a flat piece of iron (*hal patta*, হালপাট্টা), such as is used for binding boxes. The *ghor* is then placed in the *aphuri* (paragraph 5, § 12) in a clear space which has been made for it in the charcoal, and the ornament carefully put inside. The whole is then covered up with red charcoal, and the *bhati* (paragraph 5, § 11) applied. Very shortly the *ghor* and its contents are red hot, the enamel melts and forms a solid mass in the places it had just previously occupied in a state of paste. When cool, the ornament is boiled in a solution of limejuice and water. It is then carefully examined to see if there are any spaces without enamel where enamel ought to be. If there are, more enamel is added, and the heating and boiling gone over again. The process of applying and melting the enamel is known as *Bharandía* (ভাৰণডিয়া). When it is finally perceived that no enamel is wanting, the workman takes up the *khán*, and files the ornament until the surface of the enamel corresponds exactly with the upper edge of the gold wires. The latter then look as if they had been inlaid. While being filed the article is kept wet. It is then boiled again in the solution mentioned above and, when cool, brushed with a small bundle of hog's bristles called *pachrangi* (পাচৰঙ্গি) and filed again. This is repeated two or three times, until the object presents a perfectly smooth, albeit unpolished, surface. To put a polish on the enamel some care is needed. The ornament is put again under the *ghor* in the middle of the

fire, and red charcoal piled up around. The *bháti* is not used, but a hand-*punkha*, or fan, instead. When the article is red, and it is seen that the enamel is again in a state of fusion, the ornament is taken out of the fire, and cooled with the aid of a blow-pipe (*nalichunga*, নালিচুঙ্গা). It is then boiled once more in the acid solution, and the enamel is found to be smooth and polished. The last process employed puts a reddish colour on the gold. Into a small earthenware vessel a little water is poured, and the sides of the vessel rubbed with sulphur. Next, small quantities of salt, sulphate of copper, and the leaves of a tree called *thekera tenga* (*Ixora acuminata*, *Roxb.*), are put into water, and the solution boiled. Then a string is tied to the now almost finished article, and it is dipped into the boiling liquid, and kept there a minute or two. When taken out the ornament is rubbed with a cloth, and the enamelling process is complete.

11. Some goldsmiths employ two processes for colouring the gold. The first is known as *Borrangan* (বৰৰানগন). In this the entire ornament is covered with a thick solution of sulphate of copper, salt and water, and then heated under the *ghor* till the salts cease effervescing. If this process is insufficient, the second process, known as *Pani rangan* (পানি ৰানগন), is employed. This consists in boiling the ornament for a minute or two in a weak solution of sulphur and water.

12. The following list comprises almost all the articles in which enamel forms the main decorative feature :

1. *Gajera* (গজেৰা).—This is a boat-shaped shell of gold, suspended from a necklace (*dhár*, ধাৰ) of coral and gold beads (coral=*poyál*, পোয়াল; beads=*moni*, মনি). One side only of the *gajera* is enamelled, the back being engraved gold. The inside is filled with lac. The value varies with the size and the quantity of gold, the price being usually Rs. 80 to Rs. 100.

2. *Thuriá* (থুৰিয়া).—These are a pair of ear ornaments for women, in the shape of small cylinders about $1\frac{1}{2}$ inches long. One extremity of each expands into a kind of flower, often ornamented with stones. The sides of the cylinder only are enamelled. The price runs up to Rs. 140.

3. *Keru* (কেৰু).—Very similar to the above, but smaller. Price about Rs. 40.

4. *Biri* (বিৰি).—A cask-shaped locket, attached usually to a necklace. Often a row of these forms a semi-circle. One side is enamelled, the other either plain or set with false rubies. They are worn both by men and women, those used by the former being much smaller than those seen with the latter. Those worn by men cost Rs. 15 or Rs. 20, those worn by women from Rs. 80 to Rs. 100.

5. *Dugdugi* (দুগদুগি).—A heart-shaped pendant for a necklace, very graceful in form, and usually tastefully decorated with an elaborate gold wire pattern set in the enamel. One side only (that which rests on the bosom) is enamelled, the other being usually set with stones.

III.—Iron smelting in the Khasi Hills.

13. Iron smelting is carried on at many places in the Khási and Jaintia Hills. The ore is found in the largest quantities at Nongkrem and Nuspoong, where the mines are the property of private persons. It is usually mixed up in a state of fine division with a reddish brown sand, which occurs in mounds or small hills at the abovementioned places.

14. Along the foot of the particular mound of sand which is being worked, a small hill stream is made to run. Into this the sand is allowed to fall, as it is dug out of the face of the hillside. The stream, after leaving the spot where the sand is dug, passes on into a carefully-prepared channel with a wooden floor about 9 inches or a foot wide. The sides of the channel are of stone and about a foot high. The wood begins about 30 yards from the place where the sand is usually dug, and continues till the ore-bed is reached, this structure being about 170 yards from the sandhill. The incline is rather steep and the water runs fast down the channel. The channel opens directly into the ore-bed, but at about 3 feet above the opening, and again at about 20 yards from it, escape channels are built. When the sand is being dug and the ore is being washed down, the water flows down the first escape (that furthest from the ore-bed), the channel being closed just below where the escape opens by a plug of clay. Just above the opening, that is, in the direction from which the water comes, two slabs of stone jut out into the stream an inch or so from each side of the channel. These form projections, against which are placed small slips of reed when the ore is being washed down.

15. The above having been premised, the actual process of washing may be thus described :—A number of men go to the sandhill and proceed with crowbars to dig the sand and shovel it into the stream below. At the same time a man is sent to close up the channel just below the first offset. This he does by simply throwing in a few sods. Sand-digging goes on for some hours, and a turbid mass of water continues all the time to escape by the first offset. When it is considered probable that ore is beginning to appear in the neighbourhood of the first offset, a man sits down close to it with a bundle of reeds beside him. Every now and then he takes up some of the water to see if it contains ore. As soon as he finds that this is the case, he puts a couple of reeds down across the channel one on top of the other, and digging at once stops. Then the stream that flows past the sandhill is cut off, and another is allowed to flow into the channel just at the spot where the wooden flooring begins. This proceeds to work the ore

and sand gradually down. Meanwhile, the man at the first offset has been examining in his hand the water as it flows over the reeds he has put down, and each time he perceives that ore is beginning to pass over, he puts down another reed, and so on until it is found that there is no chance of any more ore passing away. Then the channel end of the offset is closed with a plug of mud, and the main channel cleared of the sods that had blocked it up, and the water flows down to the second offset, below which a few sods block the road to the ore-bed. Gradually the ore works down to the neighbourhood of the second offset, and here the same device with reeds is adopted that has been described above. Then, when all the ore has been stopped, the road to the ore-bed is opened and the second offset shut off. At the same time, a small opening is made in the sods that stop the first offset, and a portion of the stream diverted, that the flow of water through the ore-bed may not be too strong. The ore-bed is built of wood. It consists of an open space about 8 feet square, sloping gently to the middle, where a board about 1½ feet wide lies in continuation of the path of the channel. A large portion of the sand with which the ore was mixed has been already washed away and the turbid stream which pours into the ore-bed has much more ore than sand in it. Men now get into the ore-bed and with their bare feet push the mingled sand and ore about on the wooden floor. The stream continues to carry away sand, and the ore is pushed up the sloping sides of the bed as fast as it is cleaned. When no more is seen to be coming down, the water is turned off and the ore heaped up and carried away. If found reasonably free from sand, it is now fit for melting. If not, it is taken to another stream, and there washed in much the same way. When finally clean, the ore is exactly like black sand.

16. The next process is the melting. The apparatus used for this is peculiar. The cupola consists of a truncated conical chimney (*u lang theng*) about 4 feet high, 3 feet wide at the base, and 1½ wide at the top, solidly built of clay, bound with four iron hoops, and placed over a deep hole in the ground. This hole is about 3 feet wide and 2 feet deep. At the bottom is a slab of stone forming the floor of the hole, and the sides are built of pieces of stone laid flat against the surrounding clay. To supply the necessary air, a very peculiar species of bellows is constructed behind the cupola. The bellows consist of two roughly cylindrical heavy bags of leather about 4 feet high by 2½ feet in diameter. The lower portion of each is strengthened by double hide, and is quite stiff. The upper is partially flexible. The bellows rest on trestle frames of wood about a foot from the ground. To the side of each which is next the other is attached a thick board about 1½

feet wide, in which, about 9 inches from the top, a hole 2 inches square has been cut. Against this hole, but inside the bellows, is hung a heavy block of wood covered with skin with the hair outwards. The bellows stand about 6 inches from each other, and are connected at the top by a few straps of leather. Looking at them from the direction of the cupola, it is clear that they can be moved together out of the perpendicular to either right or left, but not forwards or backwards owing to the boards that run up the inner sides. The flexible upper half can be crushed down towards the outside as far as the top of the inflexible portion, and this compression naturally drives the air out of the hollow within. Two bamboo pipes, cemented when in use with clay, convey the wind from a hole in the bottom of each of the bellows to a clay tube, which runs into the hollow below the chimney. The strap connecting the bellows is attached by the middle to a bamboo, the other end of which is fastened to the roof. This bamboo allows a considerable amount of lateral play to the bellows without actually permitting them to topple over. The work is done by two women, who mount the bellows, each putting one foot on the flat top of each. They lean against boards put up for the purpose of resting their backs, and connected with strong poles which run up to the roof. By a sidelong swinging motion they press first one and then the other bellows down, working together in unison. Taking them in a position of rest, the flanges lie against the holes in the boards, and both bellows are partially distended. When the first pressure occurs towards, say, the left of the observer, the space inside the left bellows becomes contracted, and the air, being forced out through the hole at the bottom and not able to get out fast enough, presses the flange against the hole. At the same time, the space in the right bellows being enlarged, air rushes in and forces back the flange. The next moment the process is reversed, the bellows are both sent over to the right, the right flange closes as the air is forced down the right tube, and the left flange is pushed back as air rushes into the expanding enclosure. The clay tube which conveys the air from the two bamboo bellows is about 3 feet long, and, passing into the chamber below the chimney, rests almost against the side of this chamber. The air as it enters is, therefore, well diffused through the chamber. Close beside the cupola stands a large wooden trough containing water and ore mixed up into a coarse paste.

17. The process of smelting is as follows :—The fire having been lighted, the long clay pipe is carefully introduced through an orifice at the back of the cupola, and pushed as far as possible in. Then a shorter pipe is attached to the nozzle, and this is cemented with wet clay to the two bamboo tubes that come out of the bellows.

A couple of women get up on the bellows, and proceed to work them from side to side, and the furnace begins to roar. Next a quantity of dry bracken is put into the trough where the ore is, and well rubbed about there, till the fronds of the fern are all black with ore. The whole bundle is then put on the fire, and a lot of charcoal poured down the chimney on the spluttering mass. In about 1½ hours the ore is found to have been melted. The bellows and furnace are then disconnected, and a lump of red metal is pulled out of the charcoal. This is placed in some sand close by, and patted into a rough ball by an iron flat spoon called "*kajingthap*," then cut almost in two by a sort of axe called "*usdia*." This last is done to show the grain. The cut blocks sell for about 2 annas a piece.

18. The instruments used in smelting are the following :

1. *Narsuh*.—A long iron bar with a wooden handle used in stirring up charcoal in the furnace.

2. *Usdia*.—A sort of rough axe used for splitting the iron blocks.

3. *Kajingthâp*.—A sort of iron bat used for beating the red mass of iron partially into shape.

4. *Kánáp*.—A pair of heavy iron pincers.

5. *Jingking*.—A pair of iron chisels used for widening the cut made by the *usdia*.

6. *Ka phah*.—The trough in which the dry bracken is smeared with the mixture of water and ore.

7. *Khongoi*.—A trough for holding water, placed immediately below the *ka phah*.

19. Blocks of the kind described are used for making *daos* (as the common bill-hooks of the province are universally called), hoes, knives, &c., but imported iron is also largely employed for the purpose. Even when native iron is used for instruments like *daos*, imported iron is almost invariably welded on to form the edge.

20. The forge is usually a separate hut from the smoke-begrimed hovel that contains the cupola. Both are alike, in the fact that there is an opening in the roof just above the fire to let the smoke escape.

21. The forge furnace is a hollow dug in the ground, with some slabs of stone around it, which partially lean over the fire on the side next the bellows to protect the workers from the heat. A clay tube and two bamboos connect the furnace with the bellows. These are not constructed like those used for the cupola, as the same quantity of wind is not required. They consist of two cylinders (*kynwoh*) made of wood, with a small hole at the side of each near the bottom. These holes are closed from the inside by flaps of leather. The cylinders are about 4 feet long by 9 inches wide, and communicate with the fire by tubes of bamboo, one of which

proceeds from the bottom of each. Just below the level of the tod of the cylinders a platform stands, upon which the operator to work the bellows takes his or her seat. This platform is reached from the ground by a small ladder. Inside each of the cylinders a valved piston (*kynsok*) works, connected with a long bamboo. The piston is a conical block of wood, with a hole through it, at one side. The lower portion of the block is bound with the skin of a *naipillang* (probably a species of fox), and a flap of leather closes the hole. The operator, sitting with her knees close to her chin (a woman usually works the bellows), takes one bamboo piston rod in each hand, and begins pushing them up and down the cylinder alternately. She arranges so that when one hand is going down the other is coming up. As the piston descends, the pressure of the air inside the cylinder closes the flap at the bottom of the piston and the hole at the side of the cylinder, and air is forced through the bamboo tube that runs into the fire. When the piston rises, the two flaps open, and air rushes in. By this means a constant current is maintained.

22. The tools used in forging are the following:

1. *Tyrnem.*—Hammer. These are numerous, and vary in size from the large heavy one requiring two hands, to the small one wielded with one arm.

2. *Kakhur.*—A kind of rake, made of a piece of semicircular wood and a long handle, and for arranging the charcoal on the fire.

3. *Narkti.*—A rod of iron with a wooden handle. When pig-iron is to be forged, the end of the *narkti* and the pig-iron are made red hot and welded together. The block of pig-iron can then be worked into any desired shape.

4. *Narbsap.*—This is similar to the last, except that it has a ring at the end, the circumference of which lies in a plane at right-angles to the length of the handle. When articles have been partially shaped on the *narkti*, they are cut off, and one end, which has been beaten thin, is shoved into the *narbsap*, which holds the iron till it is finally finished.

5. *Kánáp.*—Pincers.

6. *Khuoh.*—A sort of hooked poker, used for pulling slags out of the furnace.

7. *Narshiát.*—A long rod of thin iron used for clearing the clay pipe which connects the bamboos of the bellows with the fire.

8. *Rynieng.*—Anvil.

23. The articles manufactured are the ordinary instruments mentioned above, *daos* and agricultural implements. *Daos* are frequently edged with steel, bought in the bazar, and imported from Europe. The steel is usually sold in small square bars at about Rs. 10 a maund in the Khási Hills. It is used also for the ends of hammers and the edges of knives, axes, sickles, and hoes.

ERI SILK OF ASSAM.

By H. Z. DARRAH, Esq., *I.C.S.*, 1890.

The *eri* silk of Assam is the produce of a polyvoltine worm known as the *philosamia ricini*, which feeds on the castor-oil plant (*Ricinus communis*) and the *keseru* tree (*Heteropanax fragrans*). The following description of it, given by Mr. Stack in his Note on "Silk in Assam,"* dated 29th February 1884, is still substantially correct :

Nature of the silk.

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6. The *eri* worm (*Philosamia ricini*) derives both its scientific and its vulgar name from its attachment to the castor-oil plant (*Ricinus communis*), called *eri* in Assamese. It feeds also on the *keseru* (*Hetoropanax fragrans*), and there are several other trees, as the *gulancha* (*Jatropha curcas*), the *gomári* (*Gmelina arborea*), and even, it is said, the common *bogri* or *ber* tree (*Zizyphus jujuba*), which the worm can thrive on in its later stages, if other food is not procurable in sufficient quantity. The *eri* worm is a multivoltine, and is reared entirely indoors. The castor-oil plant grows abundantly in the raiyat's garden, springing up from dropped seed in every little patch of unoccupied land around his house. The tending of the worm devolves principally upon the women of the family, and goes on all the year round. As many as eight broods can be obtained in twelve months, but the number actually reared never exceeds five or six, and depends a good deal upon the quantity of food which chance has provided for the worms, since no care is taken to ensure a supply by planting out trees. It is the autumn, winter, and spring broods, spinning their cocoons in November, February, and May, respectively, which are chiefly destined for use, and of these the spring cocoons are the most numerous, and yield the most silk. The broods of the rainy months—June to September—are reared for the purpose of perpetuating the stock. But both breeding and spinning, to a greater or less extent, go on all the year round.

Nature of the worm.

7. Cocoons reserved for breeding are placed in a round basket woven of bamboo, with a narrow mouth, and are hung up in the house out of the way of rats and insects. After about 15 days in the hot season, and 20 to 30 days in the colder months, the moths emerge, and are allowed to move about in the basket for four-and-twenty hours. The females, distinguished by their larger body and broader and flatter abdomen, are then tied to pieces of reed or *ulu* grass by a ligature passing under the shoulder-joint of a pair of wings on one side of the body only, leaving the pair of wings on the other side free. Ten moths will thus be tied to a piece of reed 2 feet long. The males, though left at liberty, do not attempt to fly away, but remain with

Treatment of cocoons for breeding.

* Reprinted in this volume (*vide* page 1, *et seq.*).

the females to which they have attached themselves, until the latter have laid their eggs, when the males depart. If some of the females, as may easily happen for want of any criterion of sex in the cocoon, are unprovided with males, they are exposed on the eaves of the house in the evening, and are visited by any stray males that may be in the vicinity. The female lays about 200 eggs in three days, and the life of the moth lasts a day or two longer.

Hatching and nurture.

8. The eggs are picked off the straws, wrapped in a piece of cloth, and hung up in the house. The period of hatching varies with the season: in the month of May, with an average temperature of 83°F., it has been found not to exceed a week, but in the winter it is about 15 days, and in the months of medium temperature 9 or 10 days is the usual term. When the eggs begin to hatch, the cloth is opened, and tender leaves of the castor-plant, previously crushed between the fingers to render them still softer, are supplied to the young worms for food, and subsequently they are transferred to a bamboo tray suspended in a place of safety. As the worms grow stronger, older leaves are given to them. Their supply of food is occasionally intercepted by swarms of caterpillars appearing on the castor-oil plants about the month of June. These must be carefully removed from the leaves that are given to the silkworms, and the leaves themselves washed in water. It is at seasons like these that the leaves of a variety of trees are used as substitutes for the favourite food of the worm.

Diseases and enemies.

9. Large numbers of the worms are lost by disease, of which neither the nature nor the remedy is known, but which probably has its origin in uncleanliness. No care is taken to remove the excreta, nor are the dead worms regularly rejected. The native account of the disease is simply that the worm ceases to eat and withers away. Some good effects are said occasionally to follow from sprinkling water in which *tulsi* leaves have been steeped over the worms among which this disease has made its appearance. The ichneumon fly is a deadly enemy. Its bite, which leaves a black mark, usually proves fatal to the worm at the next moulting; and if the wound has been inflicted after the last moulting, the worm spins a smaller cocoon, and dies before it is completed, leaving the eggs of the fly to hatch inside the cocoon. Rats are still more destructive, sometimes sweeping off an entire brood in a single night. The cultivator is careful to abstain from praising his crop of worms lest any of these calamities should overtake them.

Life of the worm.

10. The number of moultings is four, known locally as *hâludia, duirkâta, tinirkâta,* and *châtrikâta;* the first term denotes the yellow colour of the worm, the three others merely mark the order of the moultings. Mr. Thomas Hugon, who held the office of Sub-Assistant (corresponding to the present office of Assistant Commissioner) in the Nowgong district, contributed a very carefully-written paper upon the silkworms of Assam to the Proceedings of the Asiatic Society of Bengal for 1837, whence the following description of the *eri* worm is taken: "The caterpillar is first about a quarter of an inch in length, and appears nearly black." (The colour is, perhaps, more exactly described as a blackish yellow.) "As it increases in size, it becomes of an orange colour, with six black spots on each of the twelve rings which form its body. The head, claws, and holders are black; after

the second moulting, they change to an orange colour, that of the body gradually becomes lighter, in some approaching to white, in others to green, and the black spots gradually become the colour of the body. After the fourth or last moulting, the colour is a dirty white or a dark green. On attaining its full size, the worm is about 3½ inches long." According to one series of observations, it would appear that in the hot months the first change of skin occurs three days after hatching, and the rest follow at intervals of three days, while the worm begins to spin on the fourth day after the final change, or the fifteenth day after hatching. In the cooler months, the period before each moulting is four or five days, making 20 to 25 days between hatching and beginning to spin; and in the winter season the worm lives a whole month, or even longer.

After the final moulting, the worms are transferred from the tray to forked twigs of the castor-oil plant, with the leaves on, suspended across a piece of reed. As the worms attain maturity, they cease to feed, and crawl to the top of the fork; and if held up to the ear, and gently rolled between the fingers, their bodies emit a crackling or rustling sound. They are now placed on the *jáli*, which consists of a bundle of dried plantain leaves, or of branches of trees with the withered leaves attached, and this also, like the feeding-tray, is suspended from the roof within doors. Here they begin to spin, usually on the same day, and not unfrequently two worms will select the same leaves as their covert, and join their cocoons together. The time occupied in spinning is three to six days.

Duration of cycle.

11. It will be gathered from the foregoing that a complete cycle of the insect may be as long as twelve weeks in winter, or as short as six weeks in summer, while in the intermediate months it varies between these extremes. The maximum and minimum periods are shown in the subjoined table:

	Minimum days.	Maximum days.
Hatching	7	15
As a worm	15	32
Spinning cocoon	3	6
In the cocoon	15	30
As a moth (up to laying of eggs)	3	3
Total	43	86

The cocoons.

12. The dimensions of a full-sized cocoon are about 1⅛ inch in length by ¾ inch in diameter. The cocoon without the chrysalis weighs 5 grains. It is destitute of floss. Its proper colour is white, but a large proportion of the cocoons are of a dark brick-red colour, for which it is difficult to account. Mr. Hugon, after noting that the colour of the mature worm is either dirty white or dark green, adds—"The white caterpillars invariably spin red silk, the green ones white. However this may be, it is at least certain that worms of the same brood, fed on the same leaves, will produce dark and light cocoons indifferently. The dark colour can be purged away by boiling the cocoon in alkali water. It is said that in some places where cocoons are sold the white cocoons are sorted out, and command a higher price. There seems to be reason to believe that, with proper care in providing the worms with suitable shelter for spinning, the proportion of white cocoons could be

increased, and the quality also of the silk could be improved. Mr. C. H. Lepper, who in 1873 attempted the experimental cultivation of the *eri* worm in the Lakhimpur district on a considerable scale, found that darkness in the place of spinning was a favourable condition. Some cocoons spun in a wine-case nearly filled with loose shreds of newspaper, and with the lid closed, proved to be perfectly white and exceptionally good.

Mode of spinning.

13. In preparing the cocoons for use, the first step is to destroy the life in the chrysalis. For this purpose exposure to the sun during one or two days is usually sufficient, and this is the method preferred by the cultivators as enabling them to keep the cocoons longer, and avoiding the discoloration which is caused by fire. When fire has to be employed, it is applied under bamboo trays, upon which the cocoons are placed. Cocoons intended for immediate use are boiled for two or three hours in an alkaline solution of the ashes of the plantain stem in water, which serves the double purpose of killing the chrysalis and softening the cocoon. Usually, however, the cultivator keeps his cocoons until he has a stock sufficiently large to make it worth his while to begin to spin. He then boils them in the solution described above; or the ashes used may be those of grass, rice-straw, or the stems and leaves of the castor-oil tree, or of various other plants. In this way cocoons several years old, if they have been kept uninjured, can be softened and rendered capable of spinning. After this process, the cocoons are opened, and the chrysalis is extracted; they are next washed white, slightly kneaded in the hand, dried in the sun, and are then ready for use. The *eri* cocoon has been successfully *reeled* in Italy, and experiments have shown that it can be reeled in India, but the only method employed by the cultivator is that of spinning off the silk by hand. At the time of spinning, the empty cocoons are placed in an earthen bowl containing water, with which a little cowdung is sometimes mixed. Each cocoon is taken up separately, and the silk is drawn off in a coarse thread, nearly as thick as twine. Uniformity of thickness is roughly preserved by rubbing the thread between the finger and thumb, and in this way also new cocoons are joined on. It is said that six spinners can spin about 4 chitaks (8 ozs.) of thread in a day, consuming thereby some 1,200 to 1,500 cocoons. A seer (2lbs.) of empty cocoons will yield about three-quarters of a seer of thread.

Value of the cocoons, thread, and cloth.

14. Cocoons prepared in the manner above described are sold at Rs. 2½ to Rs. 3 per seer of about 3,600 cocoons, but the waste cocoons out of which the moth has been allowed to make its way (*khola* cocoons) can be had at about one-fourth of this rate. Pierced *eri* cocoons sell in Calcutta at Rs. 60 to Rs. 70 the maund (82lbs.) Cocoons containing the desiccated chrysalis sell at the rate of 1,200 to 1,500 the rupee, or about 9 annas per seer of 700 cocoons. These prices, however, are liable to great fluctuations, and it must not be supposed that there is anything like a fixed rate for cocoons. They are nowhere offered for sale in open bázár; and whether they can be procured in the villages or not depends very much upon the character of the season. If the brood has been a plentiful one, the superfluous cocoons are for disposal; if not, the cultivator will not part with those which he has reserved for his own use. The value of the thread varies from Rs. 4 to Rs. 7 per seer, and the most important fabrics woven from it are waistcloths (*dhuti*) and sheets (*borkapor*). The latter are large

pieces of cloth about 6 to 7 yards long, by 4 to 4½ feet in width, and their price varies from Rs. 7 to Rs. 20, according to quality. The cloth is often extremely coarse, and of a dark colour and open texture, but it is always very durable, and the texture grows closer by wearing, as the nap or floss rubbed off the thread serves to fill the interstices. A superior piece of *eri* cloth, on the other hand, is nearly as white as linen, and fine enough to make a travelling dress for a lady. One excellent quality of these fabrics is their exceeding durability. An ordinary *borkapor* is reckoned to last thirty years.

Extent of cultivation.

15. The *eri* worm is cultivated to a greater or less extent in every district of the province. Being regarded as of doubtful purity, it is left principally to Rábhas, Meches, Kacháris, Mikirs, Kukis, and other non-Hindu tribes. In the submontane country inhabited by the Kacháris and their cognates, along the north of the districts of Goálpára, Kámrúp, Darrang, and Lakhimpur, almost every house has its patch of castor-oil plants, on which *eri* worms are fed. In some parts of this region the Marwari traders make advances to the cultivators in October, when the revenue is falling due, and take repayment afterwards in thread or cloth, and both these products are commonly exposed for sale in the petty markets, in the same manner as other articles of village merchandise. A good deal of *eri* is also produced in the district of Sibságar, and in Upper Assam generally the raiyat may be seen swathed in a warm sheet of coarse *eri* cloth in the winter mornings and evenings. Throughout the whole range of the southern hills, from the Mikir country to the Gáro, *eri* thread is in great request for weaving those striped cloths in which the mountaineers delight. An estimate of 183 cwt. (250 maunds) has been furnished for the outturn of the North Cachar section of these hills, and a similar amount for the Khási Hills district. The Mikirs, Kukis, and Gáros cultivate the worm for themselves, but the handsome and durable cloths worn by the Khásis and Syntengs are woven of thread procured from Mikir and Kuki breeders inhabiting the lower hills on the northern and southern faces of the range. All these people eat the chrysalis with avidity, considering it especially delicious in the form of curry. *Eri* is but little cultivated in the plains of Sylhet and Cachar.

Outturn of silk.

16. In the absence of any large markets and indeed of any regular trade in either the thread or the cloth, it would be quite useless to attempt to conjecture the probable outturn of *eri* silk in Assam. An estimate of 25½ cwt. (35 maunds) has been furnished for the produce of Kámrúp, 177 cwt. (242 maunds) for Darrang, and 205 cwt. (280 maunds) for Nowgong, but the latter district probably produces less *eri* than either of the other two, and the estimates may be regarded as mere guesswork. In no district does the produce do much more than supply local wants. A trade in cocoons, to the extent of 400 or 500 cwt. yearly, has sprung up between Goálpára and Calcutta, whence the cocoons are shipped for England. They are said to come chiefly from Upper Assam. The cloth which finds its way to the shops of the Marwari traders is by them exported to Bengal. The mountaineers of Bhutan who visit the plains in the winter carry away with them a considerable quantity, both of cloth and yarn. The quantity of cloth is estimated at 2,000 pieces, while the yarn is dyed by the Bhutias and woven into

gaily-coloured coats and striped cloths, some of which find their way back to the bázárs of Assam. The value of the silk thus exported from the three Bhutia fairs in the Darrang district last year was returned as Rs. 43,000, and probably we may allow as much more for the Bhutia trade in Kámrúp. As regards its use in the province, however, the general opinion is that the native *eri* is being supplanted by cotton goods from England. It is alleged that the cloth is procurable with more difficulty now than formerly, and it is certain that the price has risen greatly within the last thirty years. If we go back so far as fifty years, we find the yarn selling for two rupees a seer in 1834. There is, however, reason to doubt whether *eri* was more easily procurable then than it is now, and perhaps the rise of price is chiefly to be explained by the influx of money which has accompanied the development of tea cultivation. It is impossible to say whether the actual outturn is less or greater now than at any former period. There is no natural obstacle to an increase of production to any imaginable limit.

Price.

2. The only statements in the above extract which are no longer true are those which relate to price. In 1884 empty or pierced *eri* cocoons were selling at Rs. 50 to Rs. 60 a maund in the valley of Assam. Now the price is rarely under Rs. 100, and the better and whiter cocoons will fetch as much as Rs. 130. To-day, as I write, the price in the Shillong bázár is Rs. 100 to Rs. 130, according to quality, per maund. Yesterday in Gauháti it was Rs. 90 to Rs. 125.

Cause of rise in price.

3. The reason of this rise of price is the greater demand in England, and the cause of the greater demand is the discovery of machinery adapted for utilising the cocoon. It must be remembered that the cocoon practically cannot be reeled; it must be spun, and it is only within recent years that spinning machinery has been improved sufficiently to enable a proper use to be made of the intractable *eri* cocoon. The sort of material required is thus described by a merchant engaged in the manufacture of spun silk:

> The class of silk called spun silk is made, by a combing and carding process, out of the refuse of thrown silk, and out of cocoons that are damaged and not windable, and out of pierced cocoons, as we name those from which the moth in the order of nature has escaped. It is in this latter condition that I think wild silks should be found somewhere in India, and this is what I principally want. I do not wish to *wind* such silk, but to spin it into fine thread. It is no matter how broken and rough it may look, or how much it is knocked about, torn, or crushed. I only want it as free as possible from the dead bodies of the worms, and of such foreign matters as sand or branches. It will not look like silk at all till the gum and dirt are boiled and worked out of it. You observe I ask nothing from India that requires skilled labour or machinery. * * * *
> *Eri* I like best for its whiteness. I believe it breeds frequently, but I do not believe any amount of cultivation could get thrown silk out of it, I mean, of course, to be of any commercial value.

4. The earliest practical attempt at rearing the *eri* worm was made, as far as I can ascertain, in 1873. In that year Mr. Lepper, acting for Messrs. Lister and Co., went to Lakhimpur, and tried at first to get the natives to extend the cultivation of the *eri* worm, by promising to buy all their cocoons at a fixed rate, reported to have been 10 annas a pound, or Re. 1-4 per seer, equal to Rs. 50 a maund. No one came forward, and it became necessary to take up land. Mr. Lepper, in a letter to the Deputy Commissioner, Lakhimpur, dated the 7th February 1876, thus describes his operations:

Mr. Lepper's experience.

I have read with interest the Resolution on silk, and am sorry that my experience, so far as Assam is concerned, is not more satisfactory than it is.

For many years, whilst resident in different parts of the world, I have been in correspondence with Messrs. Lister and Co. mentioned in clause or paragraph 7 of the above Resolution. I was asked about three years ago to travel in Assam, and report on the possibility of opening up the silk industry of the province, in their words, "not so much for pecuniary benefit, as for the opening up of a new industry in a new province." I forwarded home samples with my reports, and the cocoons known in Assam as "*eria*" found most favour, and I was instructed to take up land and try the experiment of rearing it in quantity, so as to thoroughly prove the practicability of procuring this article in a sufficiently large quantity to pay for the necessary outlays. I believe the *eria* to be the *atticus cynthia* or the *atticus ricini*.

The district of Jorhát has certain advantages, as labour is obtainable, and the industry is indigenous, but the system of advances to natives that would have to be practised would render the attempt very risky, as large sums would have to be advanced, which would pass from one native's hands to another's, till at last the advances would travel beyond the frontier, and no possible check could be instituted. I considered this risk, for the necessarily large sums that would have to be advanced, too great, and in preference selected this district of Lakhimpur, where the food for the worm grows wild, as well as the worm itself, notwithstanding the fact of the natives (Muttucks) being, without any exception, the most idle, useless, opium-besotten race in the world. I hoped, by the assistance of imported labour, to overcome the labour difficulty.

As my instructions were to produce pierced cocoons, I had no occasion to anticipate difficulties owing to the want of skilful reelers, winders, &c., and hoped, by supervision, to train coolies to be sufficiently careful to attend to the simpler occupations of feeding, breeding, &c.

I obtained a grant from a gentleman, who had land to dispose of, in order to save delay, and commenced planting *keseru* trees, 6 feet by 6 feet apart, to the extent of about 30 acres.

The results *pro* and *con* of this experiment are as follows:—*Owing* to rats and vermin of sorts, hail, rain, and wind, ichneumon-flies, birds, &c., the worms, if reared on a large scale, must be reared in houses.

That this climate and locality is, from natural causes, most exceptionally suitable to silk growing.

That I had almost sufficient cause to believe that, with suitable buildings and attention, a rotation of crops could be obtained, that would follow each other day by day, *i.e.*, if the breeding and hatching were carefully attended to. *That*, consequently, although from the fact of there being less vegetable growth, though not entirely a cessation of growth, there would have to be a diminution in the yield of the winter crops, yet there would be constant employment for the labour and a constant outturn of silk throughout the year, which my experience of China, Japan, Italy, France leads me to believe is quite exceptional.

That the appearance of the cocoon can be much improved by special attention, at the time of spinning, to the materials amongst which the worm is allowed to spin.

That the darker the locality allowed for spinning the better.

That the best cocoons were spun in a wine-case nearly filled with loose shreds of newspaper, the lid of which box was closed. These cocoons were beautifully white, and were reported on by Messrs. Lister and Co. as quite exceptional.

That the *eria* feeds on either the castor-oil plant or *keseru* tree, and will change from one food to the other if obliged, although the natives state the contrary.

That the castor-oil plant would be a great nuisance and an unhealthy jungle to cultivate, and that the *keseru* can be had in any quantity from the jungles, and can be plucked for leaf in the second year slightly and plucked hard in the third year.

That I could procure as many *keseru* plants of sizes at the rate of 160 per rupee from the natives as I required, and that as they are very hardy, they do not require to be brought in with earth round the roots. The *keseru* tree is constantly throwing out fresh leaf, so that it is very favourable to the rearing of worms in different ages.

No less than eight different kinds of silkworm-feeding trees were growing wild within 100 yards of my bungalow.

That the style of house usual to this district, in that it is not rot damp, and fly proof, is not suitable to rearing silk, as I had three-fourths of a crop destroyed in one night.

That, owing to the want of labour, and the cost of labour being so great, it would cost £3,000 to erect suitable buildings for a small experiment, and, as I was acting for a private firm, I could not recommend this outlay on an experiment that might prove a dead loss from unforeseeable circumstances.

That, to do Messrs. Lister & Co. credit, they still wished in the face of the outlay to continue the experiment, and that I had some difficulty in persuading them to allow Government to take the first step in a matter of such public interest.

We are here close to China, separated only by a few miles, say under two hundred, and the road is closed by a few dirt-clad savages. As soon as that short two hundred miles is open, and those savages made to respect our rule, so soon will sericulture be practicable and astonish people with its unknown resources in Assam.

Any further information Government may desire I shall be happy to forward, and regret that, as I am just leaving on tour, I have had to hurry this report more than I should have done had I had more time.

Mr. Lepper's further enquiries.

5. Later on, in June 1880, when Mr. Lepper had long left Assam, he wrote, under Mr. Lister's instructions, making enquiries as to the possibility of obtaining *eri* cocoons, pierced or unpierced, in fair quantity. In this letter Mr. Lepper wrote as follows:

The difficulty of collecting and the apathy and independent position of the peasantry in Assam have always appeared to me as sufficient to prevent any large enterprise of this nature succeeding, and I have always so represented the case. Mr. Lister, having now read the Chief Commissioner's paper again, is led to believe in the possibility of opening up Assam for silk, hence has asked me to write for the above information.

Such information as was available was sent to Mr. Lepper, but, no supply of cocoons being obtainable, nothing came of Mr. Lister's action.

Enquiries from England.

6. In 1884, Mr. Stack's Note on Silk in Assam was published, and communications opened with an English firm. The great demand in England was for *eri* waste, *eri* cocoons from which the moth had escaped. A representative of the firm I have mentioned placed in my hands at the close of 1884 a sum of £300, in the hope that I should be able to obtain for him a considerable supply. But the price he was prepared to pay then, Rs. 50 per maund, was not enough, and no quantity could be obtained. As far as I could gather, the native merchants who were in the habit of buying up from villagers were prepared to pay this and more for such consignments as they could collect, and as it was only from them that a reasonable supply could be obtained, it was evident that the price offered from home could not be expected to produce a supply. A partner of the firm himself came out to Assam at the close of 1884, and in January 1885 I met him at Jorhát. He visited, besides, Nowgong and Shillong, and made private arrangements with a Nowgong tea-planter to grow a small acreage of castor-oil plants, and try rearing the worm. No details as to this experiment were furnished to Government, but I was subsequently informed by the planter that it proved a failure, owing to blight and too severe plucking destroying the castor-oil plant.

Early experiments.

7. In 1886, the subject of growing *eri* silk received a good deal of attention. I had obtained from the Local Government permission to offer to pay half the cost of any experiment, provided the experimentor would give me statistics, as to cost, outturn, area, &c. Many tea-planters promised to try, but no one carried an experiment through to completion. Mr. Crowe, of Pathalipam, put down two acres of castor-oil plants, but the ground was washed away by the Subansiri, the river which flows close to his garden. The results of his

experience are given in Appendix A. Also in 1886 three other tea-planters undertook to try experiments, but they were never completed, and no statistics of any kind were obtained or furnished.

Mr. Campbell's first experiment.

8. In the same year Mr. A. C. Campbell, Deputy Commissioner of Kámrúp, tried at his own expense the rearing of the *eri* worm on a scale unusual in Assam. He had, in the compound of one of his houses a large iron-roofed building, and in this he erected shelves and had worms reared. Not having any castor-oil plants growing on his own premises, he was compelled to have leaves brought in cart and boat-loads from all directions. This proved a work of much difficulty and trouble, as the worms ate voraciously, and consumed a surprisingly large quantity of leaf. Two or three crops of worms were raised, but unfortunately no statistics were kept. Some information was, however, sent to me in Mr. Campbell's letter of the 1st June printed in Appendix B.

I visited Gauháti in August, and the note I wrote for the information of the Chief Commissioner is given in Appendix C.

On the occasion of this visit Mr. Campbell and I worked out an estimate of the probable cost to be incurred and the profit to be obtained. This is given at the end of the above note.

Prices, I may remark, are very much higher now than they were in 1886.

Mr. Campbell's second experiment.

9. The absence of disease was so encouraging, the only difficulty apparently being the procuring of a sufficient supply of food, that Mr. Ward, then Chief Commissioner, sanctioned a grant of Rs. 1,200 to enable Mr. Campbell to grow 20 acres of castor-oil plant, and to try the experiment of rearing on a still more extended scale. Seed was procured from Bengal, but when sown it came up unsatisfactorily, and in May 1887 Mr. Campbell reported that he had been obliged to procure leaf from outside his own premises, and that he had lost some small batches of worms from disease. He then changed his rearing quarters, thinking that new premises might prove more healthy, and towards the close of May had over a lakh of worms feeding, and had some thousands of cocoons. Before the end of the month, however, disease broke out and almost the whole crop died off. Specimens of the diseased worms and cocoons from this batch were forwarded to Mr. Wood-Mason, Superintendent, Indian Museum, who pronounced the disease pébrine. His report is given in Appendix D.

The loss caused by disease in this crop fell on Mr. Campbell, who had declined to use any portion of the grant beyond what had been spent on the seed from Bengal. Nothing further was done

in the matter by Mr. Campbell, or any one else on the Assam Valley side. Mr. Campbell's final conclusions are given in Appendix E.

Agreement with Mr. Mackenzie.

10. In the course of correspondence in 1888 with Mr. Wardle, the English silk specialist, I learned that Mr. F. Mackenzie, of Cachar, had for some time been interesting himself in the *eri* worm, and on communicating with Mr. Mackenzie, I found him prepared to carry out an experiment on the terms originally sanctioned by Mr. Ward. I laid the matter before Mr. (now Sir Dennis) Fitzpatrick, the then Chief Commissioner, and in November 1888 he authorised my concluding arrangements with Mr. Mackenzie on condition that the cost to Government should not exceed Rs. 1,500. The exact terms of the agreement made are detailed in Appendix F.

Mr. Mackenzie's anticipations.

11. Mr. Mackenzie was very sanguine of success, and believed that there was money to be made out of *eri* silk. In August 1888 he wrote as follows :

During the ten years I have been in this country, I have had opportunities of seeing these worms in many parts of this district, and during the last four years I have continuously kept a small quantity in an out-house adjoining my bungalow, with a view to improving the cocoons in size and quality by careful breeding, and to study thoroughly the diseases they are subject to.

1. As to *climate.*—The warmer and moister the climate in which the worms are bred, the shorter will be the "cycle" (*i.e.*, the period of their life from egg to moth), and also the larger the worms and cocoons produced. The warmer and moister the climate, the more vigorous will the growth of the *castor-oil* plant be. On the other hand, worms raised in a cooler climate (say Shillong as compared with the plains) yield a considerably finer and stronger silk.

2. As to *diseases.*—While studying at the University of Edinburgh I made a speciality of this subject. I find that the *eri* worm is almost entirely free from disease. Occasionally, but very seldom, a worm may be noticed with a pébrine-like spot or spots, but in almost every such case the worm dies before attaining maturity, and if it lives and eventually produces eggs, the disease does not appear in the next generation. At present, therefore, we may assume that the *eri* worm is free from *hereditary* disease.

3. As to *cost of production*—

	Rs.	a.	p.
One acre of land cleared and planted with castor-oil plants	20	0	0
Cultivation during one year	9	0	0
Twenty thousand worms, 10 cycles, feeding and manipulation during one year	90	0	0
Buildings, trays, original supply of eggs	70	0	0
Superintendence, &c.	15	0	0
Boxes, packing, freight to London	12	0	0
	216	0	0

200,000 cocoons (20,000 × 10 cycles) = 200 lbs., at Rs. 140 per maund = Rs. 350.

Therefore, profit from 1 acre of castor-oil plants in one year = Rs. 184. This expenditure is rather over than under estimated. The buildings would last for three or four years, although the whole of their cost is debited against the first year. The castor-oil plants put out in the first year would also suffice for two years, while no account has been taken of the profit from sale of the castor-oil seed produced from these plants. I have had pierced cocoons valued in Calcutta and also at the last Manchester Exhibition. An average rate is 2*s*. 6*d*. per lb.

Life history.

12. Mr. Mackenzie gives the following dates for the life history of certain worms observed in 1887 and 1888:

1887,	May	18	...	Cocoon spun.
„	June	5	...	Moth emerged.
„	„	15	...	Eggs hatched.
„	July	6	...	Cocoon spun.
1888,	September	9	...	Cocoon spun.
„	„	28	...	Moth emerged.
„	October	10	...	Eggs hatched.
„	November	3	...	Cocoons spun.

From these instances, it would seem that the life periods, allowing three days for the life of the moth, are as follows:

Chrysalis	...	...	18 to 19	days
Imago	...	...	3 „ 4	„
Egg	...	...	7 „ 8	„
Worm	...	...	21 „ 24	„
Total period	...	...	49 „ 55	„

Beginning of experiment.

13. Mr. Mackenzie began clearing in January 1889 a small piece of sloping ground on a spur of the Jaintia Hills about 8 miles from his house at Kallinecherra, and 1 mile from his out-garden, Nutwanpore, and just within the boundary of the Khási Hills district. The jungle, principally bamboo and long grass with a few small trees interspersed, was cut, and when dry burned. The area proved to be 30 acres, and for this he received a lease for two years rent-free from the Deputy Commissioner, Khási and Jaintia Hills. By the close of February 20 acres of this land had been sown partly with Patna seed and partly with the Cachar variety. The sowing began on the 15th of February. The land was staked, as for tea-planting, 4 feet × 4 feet apart, and at each stake a hole made of 1 foot cubic contents, the earth broken up and filled in again, and three or four seeds planted an inch below the surface. Several seeds were put in, because the castor-seed was not very fresh. It will be observed that the entire surface of the land was not dug up, but only the sites of the future

plants. The object of this was to prevent the rich surface soil being loosened and washed down the slopes by rain. At the same time a number of rearing sheds and other houses were taken in hand. Rain fell during March, and by the end of that month the crop was looking healthy, and the sheds and other houses had been completed, and were being fitted with trays.

April. 14. During April the rain was heavy, and a hailstorm did some damage, a loss estimated at about 5 per cent. occurring amongst the young plants, owing to crickets, hail, &c. Fresh seed was put down, whenever the plants died. It was observed that the plants looked most healthy at the places where the greatest accumulation of wood ashes had occurred from the burnt jungle. Many of them, by the end of April, stood 4 feet high. At the same time 2 acres that had been planted out were found too low and 2 acres of more sloping land was sown with castor. Continual hoeing was necessary all through March and April to keep down the weeds, and some of the more sloping parts of the plantation were terraced to prevent the loss of loose surface soil.

May. 15. During May the deaths among the young plants, especially from the Patna seed, were very numerous, and amounted to 30 per cent. according to Mr. Mackenzie's estimate and to 50 per cent. according to the report of Mr. Young, the Forest Officer, who visited the garden on the 12th of June. Mr. Mackenzie attributed the cause to the climate being much wetter than that at Patna. The rainfall at Kallinecherra is reported to be 260 inches. During May 33 inches were recorded. All blanks were filled up with Cachar seed, and continual hoeing went on to keep down the weeds. During April about 4,000 worms were raised from eggs, and these by the end of May had spun their cocoons. Half were kept for breeding, and from the remainder the chrysalides were extracted. Mr. Mackenzie describes the breed as follows :

> The eggs from which these 4,000 worms were raised were the produce of several years' careful breeding of each cycle, only the largest and finest cocoons being used for the continuance of the breed. The worms thus produced are nearly twice as large as those the Mikirs have, and spin a very much finer and whiter silk. Red cocoons are quite unknown among them.

June. 16. By the end of June, in which month 52 inches of rain were recorded, Mr. Mackenzie found that a very large number of the young castor plants, even those grown from indigenous Cachar seed, had damped off, and came

to the conclusion that sowing in the rains was ineffectual. On this point he writes as follows :

The seeds germinate freely, and grow rapidly to a height of 5 or 6 inches, and then many of them damp off and die. Large plants from Cachar indigenous seed do not appear to suffer from the damp and excessive rain, if planted on high ground, or on thoroughly well-drained flat land. They will not thrive on low flat land which is at all waterlogged. The critical period of their existence appears to be when they reach a height of 5 or 6 inches, before they have matured a sufficiently hard skin or bark on their stems to withstand the excessive damp. By sowing the seed in the cold-weather season (October to November by preference, for then there is still sufficient moisture left in the soil to cause germination), the plants gain this thick skin before the heavy rains set in. There remains no doubt in my mind that planting, to be successful and economical, must be done during the cold weather, and that imported Bengal seed will not do here. Therefore, Cachar indigenous or acclimatised seed must be used.

Feeding.

17. During the month about 200,000 worms hatched out from the 2,000 seed cocoons, and were fed during the month, half on castor and half on *keenchor* leaves. Mr. Mackenzie found that the following three jungle-trees are used by the Mikirs for feeding *eri* worms :

Keenchor. | *Tee-orr.* | *Tengpoy bujah roy.*

These are the Mikir names. Unfortunately, Mr. Mackenzie was unable to identify these trees botanically, or to supply me with fruiting or flowering sprigs.* The worms were fed in the house on leaves brought in from the jungle. As to the variety of food, Mr. Mackenzie writes—

The above-mentioned trees grow wild in considerable profusion in the jungle along the base of the hills, and from repeated experiments I have found that the silk produced from them is quite equal in appearance and value to that from castor-oil plants.

The catastrophe.

18. The catastrophe came in July, and is thus described by Mr. Mackenzie in his letter of the 3rd August—

During the past month (July) two very serious misfortunes have befallen the enterprise :

1. In the beginning of the month *millions* of caterpillars emerged from the bamboo jungle around, and attacked the castor-oil plants, eating every leaf bud, soft leaf stalk, and even parts of the bark. They arrived during the night, and when discovered, next day, had overspread some 3 or 4 acres. All available hands were immediately put on to picking them off the plants, and killing them, and by evening, though many thousands had been destroyed, the numbers left appeared scarcely diminished. Next

* The name of the plant on the leaves of which the people of Lakhimpur feed their *eri* worms is "*keseru*" (*heteropanax fragrans*). Possibly, this may be identical with the *keenchor*.

morning it was found that they (the caterpillars) had increased in numbers during the night, and, in spite of the most strenuous exertions, by the morning of the third day there was literally *not a leaf left* throughout the whole area.

Besides the extreme laboriousness of picking off each caterpillar with the fingers and crushing it on the ground with the foot, the moment a plant was touched nearly all the caterpillars on it let go their hold, and fell among the grass and weeds, where they were very difficult to find. As might have been expected, crowds of birds followed them, and what caterpillars escaped them returned to the jungle from which they had emerged.

The caterpillars varied in size from 1 to 3 inches, and in colour from gray to black, the smaller (younger) ones being grey and the larger ones black. Their mode of progression was very much the same as that of a leech. Having legs only at the ends of their bodies, they had to arch themselves into a bow at each step.

I have cultivated "castor-oil" plants for several years, but have never before seen them attacked by caterpillars (excepting by one or two isolated *greenish* ones of a different species).

Some of the castor plants are beginning to throw out new leaves again from the axils on the stems; some, I fear, have died out.

2. The supply of castor leaves having thus failed, the worms had to be fed upon the leaves of the *keenchor*, *tee-orr*, and *teng hanjang* trees (Mikir names), and they did well until just before they were ready to spin their cocoons, when *almost all of them* displayed the following symptoms:—they stretched back their heads and necks, retched several times, and, with a good deal of difficulty, vomited a thick slimy fluid (of a dirty white colour). Their bodies becoming quite limp and flaccid, they either fell from the leaves on which they had been feeding, or remained hanging caught on some projection. Decomposition was exceedingly rapid, the diseased worms, *almost before death*, emitting a most horrible putrid smell.

3. The other 100,000 worms, which had been fed from the commencement, on *keenchor* leaves, and were in a different house and attended by separate coolies, at almost the same time showed signs of this same disease, and almost all the worms were dead in two days. They also were commencing to spin their cocoons when attacked.

The 200,000 worms thus, instead of yielding about 200 lbs. of pierced cocoons, yielded only 17 lbs.

The disease in its symptoms resembled "*flâcherie*," as described by M. Pasteur, but, as I have not at present got a microscope of sufficient power, I cannot make sure.

Every means was taken to check the epidemic, the sick worms removed as noticed, and the healthy ones removed to other clean houses, but without result, as the disease again and again broke out. M. Pasteur says—

"La flacherie est eminemment contagieuse de même que la pébrine elle est peut être héréditaire" (in this case it was not hereditary) "ou accidentelle. Accidentelle elle à diverses causes: une trop grande accumulation des vers à leur différent agés; une température trop elévée au moment des mués une aération insuffisante; un brusque changement atmosphérique; l'emploi d'une feuille echauffée ou mouillée par la brouillard ou par la rosée; une feuille trés-dure succédant une feuille plus digestive.

This last cause might have been the reason of the worms formerly fed on castor and afterwards on *keenchor* leaves dying, *but the disease broke out*

almost simultaneously. in the house containing worms which had from the commencement been fed on *keenchor* leaves.

The houses were quite open round the sides, well ventilated, and kept scrupulously clean ; the worms were not crowded.

The hill tribes round here (Mikirs, Kukis, etc.), who cultivate the *eri* worm, inform me that this disease occurs occasionally, but at intervals of years (they say the cause is that some person having the "evil eye" must have approached the worms).

The houses have been thoroughly cleaned and fumigated, and another crop of worms is being now raised. As no castor-leaf is available at present, they will be fed on the leaves of the *keenchor* tree.

I am sending direct to the Director of Agriculture, Shillong, two bottles, containing (1) specimens of diseased worms in methylated spirits, (2) specimens of the caterpillars which attacked the "castor-oil" plants.

Weight of food.

19. The weight of leaves given to these worms is recorded in the statement below ; there was more refuse in the *keenchor* (stalk, &c.) than in the castor-leaf :

—	Day.	Castor leaf to 100,000 worms.	*Keenchor* leaf to 100,000 worms.
		lbs.	lbs.
	1st	1	¾
	2nd	3½	4
	3rd	5	5½
Worms moulted	4th	5	6
	5th	7	12
	6th	28	35½
	7th	30	41
Ditto	8th	35	49
	9th	42	61½
	10th	59	73
	11th	79	107
	12th	115	137
	13th	143	177
	14th	250	265
Ditto	15th	185	210
	16th	193	230
	17th	286	294
	18th	371	493
	19th	715	854
Most of the worms died on the 20th day, and the weight of leaf of that and the subsequent days is an estimate.	20th	1,430	1,430
	21st	1,289	1,289
	22nd	1,104	1,104
	23rd	706	706

End of experiment.

20. On the 12th of September Mr. Mackenzie wrote as follows :

As the whole of the castor-oil plants have died off from the ravages of the caterpillars, and all the *eri* silkworms have died from disease, work is altogether stopped, and the place abandoned.

There being no leaf and no worms, there was consequently no work for the coolies. And as they could not be paid for doing nothing, and could not live without wages, they were allowed to leave.

The worms among the Mikirs and Kukis throughout the North Cachar hills have nearly all died off from disease. And it seems as if there was much the same sort of epidemic as visited France some years ago.

The failure has been most disastrous to me, as I have lost every pice I have put into the concern.

However, the matter is now set at rest, and the object of the experiment gained, for I hold it satisfactorily proved that it is much too risky an investment for any capitalist to take up.

I myself shall certainly never again attempt it.

The caterpillar.

21. In a subsequent letter the following information was sent by Mr. Mackenzie about the caterpillar :

During 1886, a similar invasion of the same species of caterpillar occurred at Kallinecherra tea garden. They appeared during the night in countless numbers, and overspread a four-acre field of tea, but, curiously enough, did not touch the tea-plants, although they ate up every blade of grass and almost every weed among the plants, leaving the ground perfectly clean. * * Since the experimental operations at Kallinecherra have been stopped, I have noticed several times the same species of caterpillars in small numbers on isolated castor-oil plants in the surrounding villages and elsewhere. They are to be found at all times of the year, but in these cases were easily picked off.

Identification of the caterpillar.

22. Specimens of the caterpillar which proved destructive to the castor fields, and of the diseased silkworms were sent to the Indian Museum. Mr. Cotes examined them, and reported as follows :

The caterpillars, destructive to the castor-oil, prove to be the larvæ of the Noctues moth *Achæa melicerte* of Drury, a species which has proved very destructive to castor-oil plants in Lower Bengal and in Madras, see *Indian Museum Notes*, Volume I, paragraphs 52 and 104. A supply of the insecticide, London purple, was sent to Madras last January for experiment in destroying them. No report has, however, been yet received as to the success of the treatment, which would probably be inapplicable in the case of castor-oil plants grown for feeding *eri* silkworms, as the London purple would be as fatal to the silkworms as to the pest. The species is a common one, occurring all over India, besides in Ceylon, Celebes, and Australia.

With regard to the diseased *eri* worms, the disease is undoubtedly *flacherie*. I have examined the contents of the digestive tract of some of the caterpillars, and, certainly in one instance, I have made out unmistakeably the chain ferment *streptococcus bombyces*, which is characteristic of *flacherie*. Ferments of this kind are always difficult to make out in alcoholic specimens. My not having found the ferment in large quantities does not, therefore, I consider, in the least affect the practical certainty that the disease is *flacherie* ; while Mr. Mackenzie's description of the symptoms, which are precisely those of the *flacherie* of the mulberry silkworm, leaves

no room to doubt. I am particularly interested in finding this undoubted case of *eri* worms affected by *flacherie*, a disease which is so intimately connected with the fermentation of the mulberry leaf, that it might have been supposed that it would not affect the *eri* worm, which feeds on a totally distinct plant. * * * *

The small quantity of cocoons produced were sold in Calcutta at the rate of Rs. 140 per maund.

Cost.

23. The total cost of the undertaking was Rs. 2,391-5, of which Rs. 185-5-9 was subsequently recovered from the coolies who had received bonuses. The net cost was, therefore, Rs. 2,205-15-3, and half of this, or Rs. 1,182-15-8, was paid by Government, and the balance by Mr. Mackenzie. Details of the expenditure are given in Appendix G.

Mr. Mackenzie's conclusions.

24. Mr. Mackenzie thus sums up the experience he had gained by the experiment:

Were I again to make a castor plantation, I would clear and sow the land with germinated seed and with manure in October or November, so as to have good large plants, with strong hard-skinned stems, by April, which would withstand the extreme wetness of the Cachar rainy season. Here the plant is a perennial. I would also, when sowing the seed, apply a handful of cowdung and wood ashes, to the effects of which the castor-plant is peculiarly amenable. And, finally, I would keep a good broad belt (say 10 yards at least) of hoed land between the plantation and the surrounding jungle, if any.

Some minor details as to the experiment, which it was thought unnecessary to put into the body of this account, have been given in Appendix H. A note on growing the food for the worm has been recorded in Appendix I.

Extent of buildings.

25. The first observation that has to be made on the above experiment is that the expenditure incurred in buildings was out of all proportion to the number of worms which the leaf available the first year could be expected to support. The seed was only sown in February, and it was hardly possible to hope that during the first year many worms could be reared. But Mr. Mackenzie evidently expected, perhaps relying largely on the supply of food from the jungle, that he would have a very extensive crop of silk, and made arrangements for breeding on a scale which appeared to me altogether too high. However, as the main object of Government was to assist a new enterprise and, if possible, inaugurate a new industry in the province, it would have been undesirable to interfere to any material extent with the arrangements of the manager, on whom necessarily depended very largely the success of the enterprise. In deference, however, to my representations, Mr. Mackenzie built nothing further after the end of May.

Plants too young.

26. The second observation that would probably strike the reader of the preceding narrative is that it was almost hopeless to expect the castor-oil plants to bear much plucking during the year in which they were sown. In this respect, Mr. Mackenzie was undoubtedly too sanguine, but he, no doubt, trusted to a large extent to finding food for his worms from the jungle trees, on the leaves of which the Mikirs raise many of their broods. There can be little doubt that the plan to work on, should any future attempts be made, is to grow the castor-oil first, and to let it get well established by, say, a year's growth before any attempt at plucking is made. Had this been done during this experiment, the expenditure incurred would have been very trifling, and we should have learned almost as much as we know now.

Inadoquate supervision.

27. The third point to which I would draw attention is the fact that the locality for the experiment was no less than eight miles from Mr. Mackenzie's house. I did not learn this until the experiment had gone too far for any change to be made. There can be little doubt that this most materially lessened the amount of Mr. Mackenzie's supervision. In a new enterprise of this kind, it is absolutely essential that the manager should be perpetually present. So much often depends on prompt action that it is perfectly possible Mr. Mackenzie's presence on the plantation when the swarm of caterpillars was first announced might have enabled him to devise some better means of getting rid of them than the clumsy and tedious process of picking them off. As the caterpillars could not fly, they must have travelled over the ground from the neighbouring jungle or been the produce of eggs laid on the castor-oil plants. If the latter had been the case, the insects would have been perceived coming to maturity, and the plague would not have been so sudden or destructive. Consequently, they must have travelled across the ground from the neighbouring jungle. There must have been a clear space, be it however narrow, between the castor oil and the jungle. The question that strikes a stranger who has not visited the spot is—Could not they have been stopped when coming? Fresh swarms must have kept on coming across all the time the first arrivals were being picked off. Similarly, when we are told that the difficulties of killing them were increased by their falling off at the least touch into the weeds and grass at the foot of the trees, one is inclined to ask—Why was there enough grass and weeds to conceal them? There was a fairly strong labour force on the garden, and the hoeing is shown as having been carried out to a considerable extent. Had Mr. Mackenzie been constantly on the spot, as he no doubt would have been, seeing how interested

he was in the experiment, but for the unfortunate interval of eight miles, it is difficult to believe he would have allowed much jungle in his plantation. In all parts of the world, and in all kinds of work, the presence of the owner and manager, the person directly interested in success, is essential to efficiency; but in India, where everything goes immediately to ruin the moment that supervision is removed or relaxed, and in a new enterprise in which the procedure is strange, and the methods far from assured, it is doubly necessary. Had I supposed it possible that the experiment would be attempted out of reach of the manager's eye, I should certainly have inserted a condition in the agreement, making it necessary that the area under castor-oil should be within half a mile of Mr. Mackenzie's house.

Eri silk as a commercial product.

28. This experiment and the others which have preceded it have shown us, I think very clearly, what are some of the dangers to avoid, but I do not think it has proved that *eri* silk is a thing on which capital cannot be profitably spent. Personally, I am still of the opinion I have held for some years, that *eri* silk has great potentialities, and though every one of the attempts above described has failed to prove that its culture can be conducted on a commercial scale, I believe that the time will come when much capital will be embarked in it, and when it will form one of the most important staples of Assam. The climate is an ideal one for the growth of silk. The food of the worm is almost a weed in many parts of the province, and actually a weed in others. The worm is exceedingly prolific, and the labour required for rearing it is such as can be given by the decrepid and infirm members of the community. This sort of labour exactly suits the Assamese, to whom even the light work of a tea garden is repugnant. The produce required needs no skill in the handling; reelers are not wanted; nothing but the empty shell from which the chrysalis has been extracted or the moth has escaped is asked for in England, and for this commodity the demand far exceeds the supply. It is difficult to imagine a combination of circumstances which promise fairer for the commercial success of any commodity. If then a small amount of capital were to be invested in this enterprise by a man who was prepared to watch closely all details, to live on the spot where his castor-oil plants were, to record carefully all facts, however unimportant apparently, connected with his experiment, I have no doubt whatever but that he would find out why all experiments up to date have been failures, and would inaugurate an industry that would render profitable again the land of many an exhausted tea garden in Assam.

29. As I believe that this experiment will again be made, and that sooner or later it is bound to succeed, I would venture to make some suggestions as to the manner of conducting it, based on the experience we have gained from the past. In the first place I would select, in an *eri*-producing tract, and where the small amount of local labour required was procurable, a piece of land about 20 acres in extent, an old homestead for choice, at not less than a mile from the nearest jungle, and with open fields, no homesteads, all round it. The homestead soil, we know from what we see daily in the plains, suits the castor-oil plant, and is never flooded, and the distance from jungle would help to minimise the danger from caterpillars, while the open fields all round would tend to prevent caterpillars which had reached other patches of castor-oil in the neighbourhood from reaching the experimental plot. In the second place, I would use the ordinary seed obtainable in Assam, and would put it down during the rains, say in July or August. This is the usual sowing season in Upper India, where the crop ripens at the end of the cold weather Thirdly, I would give the young plants a start of as nearly a year as possible before beginning plucking. If put down in July, they should be fit for plucking by the following April. In the fourth place, I should provide ample accommodation for feeding, so as not to crowd the worms too much, and should do all my building during the cold weather on the driest land I could find in the neighbourhood of the castor-oil. Fifthly, I would plant out, also in the rains, at some distance from the castor oil field, an equal area of *kesseru* bushes, on the leaves of which the *eri* worm is said to feed as greedily as on the castor-oil. These are the principal preliminary arrangements I should recommend. When the breeding time came, say in April, I should start with white cocoons only, the largest and whitest I could procure. When the eggs were laid, I should examine the bodies of the moths microscopically in the ordinary way for signs of pébrine, using only for breeding the eggs of those free from the disease. Various devices would have to be tried, so as to find out why some cocoons are red and some white. Natives cannot say what the cause of the difference is. Perhaps, Mr. Lepper's plan of allowing spinning only in the dark is the way to get white cocoons. But whatever it is, there is little doubt that intelligent supervision, never, as far as I know, applied to this point as yet, will solve the mystery, and equally little doubt that, as the white cocoons are much more valuable than the red, the discovery will be most profitable from a pecuniary point of view. All through the process of feeding the leaf would be

Method of conducting the next experiment.

weighed, so as to ascertain not only what weight of leaf a worm consumed, on the average, in the course of its life ; but also the weight that could be removed from each acre of castor-oil and *keseru* without injury to the plants. The presence of the two varieties of food would enable a comparison to be made as to which suited the worm best, and which was the more economical to use. Accurate statistics would, at the same time, be kept to show the exact cost of producing a given weight of empty cocoons, and also the weight that a given area of castor-oil plants or *keseru* bushes would support. No experiment has yet been made quite on these lines, and until it has been made, and has failed, I shall refuse to believe that there is no future before the *eri* silk of Assam.

APPENDIX A.

Extracts from letters from H. M. CROWE, Esq., to H. Z. DARRAH, Esq.

(i) Letter, dated the 19th February 1886.

I put out an acre of castor-oil, have manured it, fenced it in, and all, and am now putting another acre in the bund on the river bank (*chapari*) land liable to inundation. It appears *eri* thrives better in this land, requires no manure or care. The seed is not up yet, so I have not made out any account. As soon as it is, I will then let you know all about it. Your estimate I thought very excessive, it cost me nothing like it. I have also gone in for *keseru*, a tree the *eri* worm feeds on, and is largely used by Assamese. It is much easier to grow than castor-oil plant, could be advantageously planted in among tea with the same result as that obtained from the far-famed *sau*. Do you know if there is any dodge about sowing the seed of the castor-oil plant ? I find they do not come up together, some not for months after the others put down at the same time.

(ii) Letter, dated the 1st April 1886.

After our meeting here in December last I started at once the proposed *eri* silk experiment, and am now able to give you the details of expenditure up to date. The plant is now six inches high, and I have everything ready to start with a batch of worms as soon as the plants are strong enough to allow the gathering of leaves :

					Rs.	a
Clearing one acre of jungle,	30	*kaziris* at	4 annas	... ...	7	8
Hoeing and breaking up land,	30	„	4 „	... ...	7	8
Two light hoeings,	30	„	4 „	... ...	7	8
Picking out roots, &c.,	30	„	2 „	... ...	3	12
Sowing seeds and raking land,	15	„	4 „	... ...	3	12
Fencing			...	... ...	12	0
Purchase of thatch, 4,000 bundles at Rs. 5				... ...	20	0
Constructing shed			...	... ...	15	0
Purchase of 80 dollas at 4 annas			...	... ...	20	0
„ of 10 baskets at 2 „			...	... ...	1	4
Total			...	... ...	98	4

This sum of Rs. 98-4-0 represents the cost of getting everything ready for the experiment and the putting out of one acre of castor-oil.

(iii) Letter, dated the 15th March 1887.

With reference to the experiment as to the cost of producing *eri* silk which I undertook, I regret to say I was unable to carry it fully out, as the Subansiri washed away the plantation of castor-oil, and I was only able to raise a few batches of worms. I found great difficulty in keeping the wild caterpillars, or *bissa*, from the plants, and I should say that this would prove a drawback to cultivation on a large scale here at any rate.

(iv) Letter, dated the 30th May 1887.

The seed comes up as soon as the weather is warm, but it is not advantageous to pluck the leaves till the plants are old; one year is not sufficient for a fair trial; last year's lot was chiefly washed away by the river. I should say that off an acre of plant, saying you began in May, the plants being about five or six months old, one could get 3 seers of cocoons each batch, one in May, July, August, and October, and, allowing for blight, &c., I do not think more than 10 seers in the year, and this with care,—care with the worms and care to keep away the caterpillars which destroy the leaves in the rains. It has been a puzzle to me to find where the Calcutta people get their pierced cocoons from, there is nothing to be done here. Silk is Rs. 8 a seer, and the common pulled thread the people make of the *eri* is Rs. 5 and Rs. 5-8. They only sell 400 for the rupee, counted in fives or 2,000 cocoons. The Lyons people want ten times that number for the same money. A Kaya buys a cloth made of coarse drawn thread of *eri*; it weighs ½ seer at the most; he gives Rs. 12 for it, and exchanges it for 20 seers of rubber; this is the local trade, and it puts Lyons in the shade entirely.

APPENDIX B.

Enclosure to MR. CAMPBELL'S letter of 1st June 1886, being a letter from his Manager, MR. DONALDSON, dated Gauhati, the 31st May 1886.

I have the pleasure of handing you the accounts of work done and expenses incurred from the 11th to the 31st May.

The establishment now consists of one woman on Rs. 5 per month to look after the worms and moths.

Seed has been planted out to the amount of 7 seers.

Young castor-oil plants were brought and transplanted into your land to the number of 502.

On the 12th to 15th instant some 804 worms at Rs. 2-4 were purchased, reared, and formed into 692 cocoons on 21st and 24th May; 112 turned out dead.

Cocoons (863) were purchased at the rate of 5 pice for 100; some of these have come out (13), and have laid eggs.

We purchased pierced cocoons and cocoons containing the dead grub to the number of 15,726. These I am having separated and cleaned. Up to date they stand thus—

1. Dried pierced cocoons	White 1,720, red 934 =	2,654
2. Undried pierced cocoons	White 640, red 4,786 =	5,426
3. Cocoons with the grub still in		6,366
4. Ditto boiled by mistake		1,280
Total		15,726

There is a great difference in the weight of these pierced cocoons—

Dried	cocoons	...	...	...	3,538 = 1 seer.
Undried	„	...	...	...	2,287 = 1 „

In purchasing these from the villagers, pierced and unpierced and undried cocoons were all mixed, and I found an average seer of these to equal 1,919 cocoons, for which they charged at the rate of 5 pice for 100.

On the 22nd I obtained a batch of young worms just hatching, I shall be able to count them soon.

Cocoons with the live grub weigh about 400 to the seer.

Letter dated the 1st June 1886, from A. C. CAMPBELL, Esq., to H. Z. DARRAH, Esq.

Please read and return the above. You will observe that the net result so far is about 16,000 shells, which, at 4,000 per seer, is 4 seers, I say 4,000, so as to leave a margin ; the actual average number per seer is about 3,700, but you will observe that we have about 6,000 seed cocoons, and if these lay eggs, several hundred thousand may be reared at a trifling cost, as two or three women are enough to feed them, and there is an abundance of castor-oil leaves fit for plucking, and a considerable area growing up with plant. The large godowns providing ample accommodation for feeding and rearing. The plucking of the leaves costs scarcely anything. I have told Mr. Donaldson to stop buying pierced and unpierced cocoons as offered for sale, the price is 5 pice per hundred, or 12 annas 6 pice per thousand, or Rs. 3-2 per seer, or Rs. 125 per maund.

From the facility with which about 5,000 worms were reared in the godown, I am about sure that the cost of rearing ought not to exceed 4 annas per 1,000, or a rupee per seer, or *Rs. 40 per maund*; but I will not have sufficient data till I have reared about 100,000 cocoons, which would represent about 25 to 28 seers. I find the cocoons reared on my premises have a much finer silk and are of larger size than the village cocoons. I attribute this to greater care being taken of them and their having an abundance of food. The village cocoons are half starved.

APPENDIX C.

Notes on MR. CAMPBELL'S Silk Experiment of 1886, by H. Z. DARRAH, Esq., dated the 15th August 1886.

I went down on the 8th August and on the 9th saw Mr. Campbell's silk experiment. He is to give me full details in the way of figures when the whole thing is over, so I have entered scarcely anything as to cost, number of cocoons, &c. The crop I saw was the second one. A very large number of worms, several thousand certainly, were feeding in a large godown. Along all the sides of the building (which measured roughly 30′ × 80′) ran a broad shelf about 4 feet wide and about 3½ feet from the ground. The shelf was made of bamboo, and supported a number of loose mats. Above the mats were four rows of bamboos suspended one above another from cross bars above. The lowest bar was about a foot from the mats, and the others separated from each other by about the same interval. On these bars bundles of castor-oil leaves were hanging, covered with worms. Most of the bundles had been reduced to mere stalks, and on these thousands of worms were

crawling about seeking for food. When we went in, about 7-30 or 8 a.m, the one man (on Rs. 7 a month) and the three women (each on Rs. 5) employed by Mr. Campbell were attending to the worms. A very large quantity of freshly-brought in leaf, about 12 feet × 9 feet × 1½ foot = 162 cubic feet, lay on the floor. The man was tying this up into bundles by the stalks, so as to allow of its being suspended across the bars that the worms might crawl on to it. One of the women was going round, examining all the worms that had crawled to the top of their respective bundles, to see how many were fit for spinning. She ascertained this by rolling the worm gently between her finger and thumb, while she held it up to her ear.* Those rejected were put back, the others carried, when a handful had been obtained, to a bar across which a quantity of dry plantain leaves had been hung. The worms fit for spinning were dropped amongst the plantain leaves, where they quickly concealed themselves, and immediately began to spin. The two other women were seated on the floor, picking worms off bundles of plantain stalks, the leaves having been eaten, and transferring them to other bundles of fresh leaves. These latter, as soon as fairly well supplied with worms, were then hung up on the bars already mentioned. At intervals one of the women would leave what she was about, and take up the clearing of the mats of refuse. The excreta of the worms was very abundant, and formed a layer, which towards the centre of each mat must have been 3 or 4 inches thick. This, be it noted, was but the produce of a single period of 24 hours. Besides excreta, the mats had on them broken off pieces of leaves and bits of stalks, as well as numerous worms which had fallen from the bundles of leaves above. These fallen worms were all carefully picked up, and replaced on the bundles, excepting of course those found dead, of which the number was surprisingly small. The remainder of the stuff on the mats was then shaken out on the ground at some distance from the godown.

*Those deemed fit were recognised by their giving a sort of crackling noise. I did not notice this myself.

Attached to a bar at one end of the building were a number of sticks made of old straw, to which a number of male and female moths were attached. The latter were tied to the sticks, the former were free. Some were dead, having laid their eggs, some pairs were copulating. In another corner of the room were a few bags of calico, containing eggs.

The worms seemed remarkably hardy. Large numbers had fallen off the bunches of leaves, and were crawling about over the mass of excreta, apparently as uninjured by the fall as they were indifferent to the material over which they moved. The women appeared to be handling them roughly, though this was more apparent perhaps than real, but the worms seemed in no way injured. In many instances the worms were not picked off the bundles, but fresh leaves were hung up besides the stalks from which the leaves had been eaten, and the worms left to transfer themselves to their new pasture grounds.

All the time that the worms were feeding, a gentle patter caused by their excreta could be distinctly heard. In another part of the building, also suspended on bars, were a large quantity of dry plantain-leaves filled with cocoons attached, just as they had been spun by the worms themselves. Apparently, the red and white cocoons were in fairly even proportions, but the white are believed to be generally the more numerous. The man in charge stated that he could tell which worms would produce

red, and which would produce white cocoons. I told him to separate a number into the two kinds, and put them in separate baskets filled with dry plantain leaves, to test the truth of his statement. He did so, and his distinction appeared to be based on the general colour of the worm, and not on any specific marking. Thus, he put all the cream-coloured worms he could find into one basket, and said they would produce red cocoons, and in the other basket he placed all the greenish tinged worms and said they would yield white cocoons. Next morning I found, on examining the baskets, that there were a large number of red cocoons in the basket supposed to yield only white ones, and *vice versâ*. Consequently, the alleged distinction was no criterion. This result led me to doubt the truth of another statement, to the effect that the thread of the red cocoon was stronger, and, therefore, more valued than that of the white. At the same time, the red cocoons looked decidedly larger than the white, an appearance which cannot have been due to any optical delusion, for if the two kinds had been of the same size, the white would have looked larger according to the well-known optical law. It appears, however, to be a fact that the red and white varieties are used indiscriminately by the people in making their *eri* cloths, and Mr. Campbell said the Kayas made no difference in the price they were ready to pay for red and that which they were willing to give for white. It would seem that the colour of the red cocoon is lost by frequent washing, or perhaps in the steeping process to which recourse is had before the cocoons are spun into thread.

Mr. Campbell gets his leaf in a hand-to-mouth fashion. He has no area under the castor-oil plant, and is compelled to depend on what he can pick up in old deserted *bastis*, or in abandoned patches of cultivation. The mauzadárs send him in supplies now and then, and he employs his elephant and the municipal carts. This carriage of the leaf has, therefore, cost him nothing, and the experiment consequently proves nothing, as far as expenditure is concerned. Mr. Campbell did not weigh his leaf, and so no figures on this point are available. Nor were moths, or eggs, or worms counted. But the produced cocoons are being counted, and frequent experiment has shown that 3,000 to 3,400 cocoons (*dry* and *empty*) go to make one seer, worth at present rates Rs. 2, or a fraction less, in the Gauháti Bázár.

The following is Mr. Campbell's estimate as to the probable cost of making a small experiment in growing *eri* silk :

	Rs.
Breaking up 20 acres of brushwood land, at Rs. 10	200
Seed at ½ maund per acre, at Rs. 3 a maund	30
Sowing, at Re. 1 an acre	10
Weedings, two, at Rs. 2 an acre each	80
Chaukidár on Rs. 7 a month to keep off cattle (fencing would be dearer)	84
Ground-rent at Re. 1-8	30
Eggs	10
One man on Rs. 10	120
Five women, at Rs. 5=Rs. 25	300
Two coolies for leaf, at Rs. 7=Rs. 14	168
Shelves, mats, miscellaneous	100
	1,132*

* In this one serious item of expenditure has been omitted, *viz.*, the building of godowns. I say "serious," because the item would be comparatively large if an extensive experiment were being tried. For a small experiment like that for 20 acres of land, *ekra* huts would no doubt answer admirably.

Mr. Campbell believes from what he has seen that one lakh of worms could be fed from one acre, therefore, 10 lakhs from 10 acres. When one-half of the area was exhausted, the other half would be used, and as there are six crops of worms in the year, each half would produce three crops. Therefore, the total crop would be 60 lakhs. But 3,200 cocoons on an average go to make up one seer, *i.e.*, six lakhs would yield 46 maunds of dry and empty cocoons. At Rs. 80 per maund, the value would be Rs. 3,680. At Rs. 70 a maund (which is much below, according to Mr. Campbell, the rate obtainable now in Gauháti from the Kayas) the value would be Rs. 3,220. The above is based on what is practically a guess of Mr. Campbell's as to the number of worms that an acre would feed.

APPENDIX D.

From J WOOD MASON, Esq., Superintendent, Indian Museum, to the Director, Department of Land Records and Agriculture, Assam, No. 394, dated Calcutta, the 17th June 1887.

In reply to your letter No. 860, dated the 26th May 1887, I have the honour to inform you that I have received from the Deputy Commissioner of Kámrúp a large number of caterpillars of an *eri* silkworm preserved in spirits and a box of live cocoons in all probability belonging to the same variety.

I have carefully examined some of the latter, and I find that they are suffering from the disease called pébrine. In fully-formed, healthy-looking chrysalises the corpuscles, which are the cause of this disease, were only present in the earlier stages of their development, but in the dead bodies of caterpillars that had formed chrysalises, but had been overwhelmed by the disease before they had time to pupate, the fully evolved corpuscles were present in countless numbers, several millions being contained in every drop of the decomposed fluids of the body.

The caterpillars belong to a variety of the *eri*, of which I had previously only received dead cocoons, and I should be glad if you could send me a few eggs of the same for cultivation in my laboratory.

With regard to remedial measures, I can only at present suggest the raising of fewer worms on the same area, and the thorough disinfection of the houses and appliances employed. Amongst the worms recently raised by me from cocoons of a different variety of Assam *eri*, there was no disease; this success may be accounted for either by my having given my worms plenty of room in a chamber free from the germs of the diseases to which silkworms are liable, or by the disease not being hereditary (as it unquestionably is in the mulberry worms of Europe and India), in the variety of the *eri* cultivated in Kámrúp, or by the smallness of my cultivation, or by a combination of all these circumstances. But these are questions that can only be answered after experiment, for which a small quantity of live "seed" will be necessary.

APPENDIX E.

Extract from letter, dated Gauháti, the 4th July 1890, from A. C. CAMPBELL, Esq., to H. Z. DARRAH, Esq.

* * * * *

I would like you to add, as my final conclusions, based on the result of rather extensive experiments, that the only way of developing the industry and embarking a large capital in it in Assam is to work it on a system somewhat analogous to indigo advances, and getting the villagers over large tracts of country to undertake the cultivation in small patches so as to avoid the fearful results of epidemics.

The Assam Duars, from Bengal to Tezpur district, are particularly well suited for carrying out my proposed scheme, as they are inhabited by Kacharis or Meches, who are accustomed to rearing the insect, as they used to pay their revenue to their former masters, the Bhutias, in *eri* cloths, and they have no religious prejudices, as the Assamese Hindus have, against rearing this description of silk.

The aid which the capitalist should give would be to take up a few *bighas* of good land near each village or cluster of villages, and cultivate it with castor-oil plant. If he cannot come to terms with the villagers, the seed will pay his outlay, and he will be no loser. If he comes to terms with the villagers, the seed will pay his outlay, and he will be no loser. If he comes to terms with them, he should say "I will give you leaf and I will pay for what additional grass sheds you may want, on condition that you give me all the cocoons you cultivate at so much per thousand or per seer, free of dead worms and other *debris*." Under such a system he might have square miles of villages, the inhabitants of which would find it more profitable to give him their cocoons rather than manufacture them into *eri* cloths for the Bhutias, who prize such cloths greatly, and were greatly disappointed two years ago when the villagers sold all their cocoons at Barpeta, and sent very few *eri* cloths into the Bhutan market.

The great point to be avoided is the cultivation of too many worms in one place, as in case of epidemic breaking out, nothing will save them, and it is most disheartening to have them buried in scores of basket loads, as I have done. The worst feature in these epidemics is that the worms will feed up almost to spinning time, thereby giving you all the trouble and expense of rearing a crop, and then, instead of spinning, they sicken and die. If they died in the earlier stages, it would not matter so much, but they only become susceptible to the ailment as they approach maturity. I am sanguine that, by spreading the cultivation over large tracts of country, a certain amount of segregation would be secured, and if we lost the crop in one or two places, we would be recouped by bumpers in others. Moreover, the cultivation of the worms is pre-eminently adapted to utilize to the utmost that description of the labour of the agricultural population which is now practically wasted, *viz.*, the services of women and children, and the spare time of adults now devoted to idle pursuits or drinking.

APPENDIX F.

Terms and conditions of the Cachar *Eri* Silk Experiment, being extract from No. 49, dated the 13th January 1889, from the Director, Department of Land Records and Agriculture, Assam, to Mr. F. F. Mackenzie, of Kallinecherra Tea Estate, Cachar.

* * * * *

1. That not less than 20 acres of suitable land, your own property, or rented by you, be planted out with castor-oil plants by the 1st of March 1889.

2. That sheds sufficient to rear the *eri* worms that can be fed on 20 acres of castor-oil plants be erected as required for the worms.

3. That broods of *eri* worms be grown as soon as there is leaf wherewith to supply them, and that they be continuously grown without intermission during 1889, and the supply increased as far as possible in proportion to the increase in the quantity of leaf.

4. That the following information be forwarded, on the 1st of each month, to the Deputy Commissioner for transmission to me:

(*a*) Area under living castor oil plants at end of preceding month.
(*b*) Area under rearing sheds at end of preceding month.
(*c*) Total weight of leaves supplied to the worms during preceding month.
(*d*) Number of worms alive on date of sending statement.
(*e*) Number of red and number of white cocoons formed during preceding month.
(*f*) Weight and number of empty white cases from which the moths have been allowed to escape during the preceding month.
(*g*) Weight and number of empty red cases from which the moths have been allowed to escape during the preceding month.
(*h*) Details of expenditure incurred during the preceding month.
(*i*) Details of profits, if any, made during the preceding month.

5. That some explanation be given, if possible, of the reason why some cocoons turn out red and others white.

6. That the life histories of some half-a-dozen or so specimens be compiled at different times, showing the period passed in the stages of eggs, larvæ, chrysalis, and moth.

7. That an attempt be made to couple the *eri* moth with the *muga* moth or with the *pat* moth, or with the moth of some other species of worm producing a finer and more reelable silk than the *eri*, with the object of producing a breed which will feed on an annual tree and yield a reelable silk.

8. That the symptoms of any epidemic that may occur amongst the worms be carefully noted down, the number of deaths, if possible, ascertained and recorded, and a few specimens of diseased worms sent to me in a bottle for microscopic examination.

9. That, should an epidemic occur, efforts be made by segregation, where possible, or by any other means that may appear advisable, for arresting the course of the disease, and that as detailed an account as possible be prepared, and forwarded through the Deputy Commissioner to this office, of the epidemic, and the attempts made to effect a cure.

10. That at the close of the year 1889 an account in narrative form be prepared by you, giving a history of the experiment, showing the total

expenditure incurred, the total weight of empty cocoons (distinguishing red from white) and castor-oil seed obtained and the profits resulting from the sale of cocoons; sale of castor-oil seed, and any other sources from which a profit is obtainable, illustrating any other points of interest upon which the course of the experiment may have thrown light, and answering any questions that may have been put by me.

11. That during the conduct of the experiment all matters connected therewith shall be open to inspection at all times by Government officers deputed either by myself or by the Deputy Commissioner, Cachar, and that any specimens or samples required be supplied free of cost to this office.

12. That whatever profits may result from the experiment shall be absolutely your property, and that Government shall have, in consequence of this agreement, no lien on any of the buildings erected for, or articles resulting from, the experiment.

13. That half the total amount of the expenditure be payable to you monthly on your presenting to the Deputy Commissioner, Cachar, an acknowledgment signed by me to the effect that all statistics and information required up to date have been furnished.

APPENDIX G.

I. Buildings and Fittings.

Main head.	No.	Details.	Rs.	a.	p.
Coolie lines	1	Coolie line, 20 *háths* × 10 *háths*, at 9 annas per *háth*.	11	4	0
	2	Coolie line, 20 *háths* × 10 *háths*, at 9 annas per *háth*.	11	4	0
	3	Coolie line, 20 *háths* × 10 *háths*, at 9 annas per *háth*, by *házari* work.	12	11	0
	4	Coolie line, 20 *háths* × 8 *háths* at 9 annas per *háth*.	11	4	0
Rest-houses ...	5	Small rest-houses, 10 *háths* square at 9 annas per *háth*.	5	10	0
Babu's house ...	6	Hut and cook-house, 12 and 8 *háths*, respectively, at 9 annas per *háth*.	12	0	0
Godown ...	7	Store-house for cocoons, &c., 20 *háths* × 12 *háths*, at 14 annas per *háth*.	17	8	0
Feeding-houses ...	8	House for feeding worms, 53 *háths* × 12 *háths*, at Re. 1 per *háth*.	53	0	0
	9	House for feeding worms, 53 *háths* × 12 *háths*, at Re. 1 per *háth*.	53	0	0
	10	House for feeding worms, 53 *háths* × 12 *háths*, at Re. 1 per *háth*.	53	0	0
	11	House for feeding worms, 53 *háths* × 12 *háths*, at Re. 1 per *háth*.	53	0	0
	12	House for feeding worms, 53 *háths* × 12 *háths*, at Re. 1 per *háth*.	53	0	0
	13	House for feeding worms, 53 *háths* × 12 *háths*, at Re. 1 per *háth*.	53	0	0
		Carried over	399	9	0

I. Buildings and Fittings—*continued.*

Main head.	No.	Details.	Rs.	a.	p.
		Brought forward	399	9	0
Spinning-houses	14	House for worms to spin in, 53 *háths* × 12 *háths*, at Re. 1 per *háth*.	53	0	0
	15	House for worms to spin in, 53 *háths* × 12 *háths*, at Re. 1 per *háth*.	53	0	0
Breeding-house.	16	Breeding-house, 30 *háths* × 10 *háths*; at 14 annas per *háth*.	26	4	0
Experimenting-house.	17	House at Kallinecherra for trying experiments in breeding moths, 30 *háths* × 8 *háths*, at 12 annas per *háth*.	22	8	0
Miscellaneous charges.	1	Thatching-grass for above, 65,430 bundles, at Rs. 2-8 per 1,000.	162	8	0
	2	Plastering walls and levelling floors ...	11	8	0
	3	Bamboo *machán* or frames (24) for the six feeding-houses, to rest trays on.	7	10	0
	4	Bamboo *machán* for the experimenting-house ...	1	2	0
	5	Making 228 trays (48 for each feeding-house), 62 at 8 annas, and 226 at 6 annas, 35 feet × 4½ feet.	115	13	0
	6	Eight trays for experimenting-house, at 8 annas a tray.	4	0	0
	7	Cane for binding *machán*	0	8	0
	8	Baskets, 1,185, for leaf and for holding spinning worms.	65	3	0
	9	Cloth, 936 yards, for covering these ...	56	6	0
	10	Eighteen balls of twine for above ...	9	0	0
	11	Sewing the cloth	7	4	0
	12	One barrel of coal-tar	24	6	0
	13	Altering walls of feeding-house	17	0	0
	14	Tarring *machán* of the houses	2	0	0
		Total	1,038	9	0

II. Cultivation of Area.

Clearing ...	1	Clearing 25 acres of jungle by cutting and then burning it.	91	13	0
	2	Hoeing out sun-grass roots	1	9	3
Staking ...	3	Staking the above, 47,000 stakes, at Re. 1 per 1,000.	47	0	0
Sowing ...	4	Sowing 20 acres stake, 2,760 stakes to an acre, 55,200 stakes in all, at 200 for 4 annas.	64	4	0
	5	Clearing and sowing two acres of half-cleared land.	14	4	6
Manuring ...	6	Manuring two acres with ashes and cowdung ...	50	0	6
Vacancies ...	7	Filling up vacancies	45	14	0
Seed ...	8	Patna seed 10½ maunds *plus* carriage... ...	54	6	0
	9	Cachar „ 5 „ „	20	6	0
	10	Sylhet „ 3½ „ „	13	2	0
Hoeing ...	11	Hoeing to 1st April	42	12	6
	12	„ 1st May	71	13	6
	13	„ 1st June	87	12	3
	14	„ 1st July	81	8	0
		Total	686	9	6

III. Procuring Labour.

Main head.	No.	Details.				Rs.	a.	p.
Commission	1	Commission to Mikir and Tipperah sardárs to get clearing and sowing done.				16	5	0
Bonus ...	2	Bonus to ten coolies for signing agreement from 11th March for one year, at Rs. 12.				120	0	0
	3	Bonus to two men for signing agreement from 17th April for one year, at Rs. 15.				30	0	0
	4	Bonus to two women for signing agreement from 17th April for one year, at Rs. 10.				20	0	0
	5	Bonus for one year's agreement from 8th May to—						
		2 men, at Rs. 15			Rs. 30			
		4 women, at Rs. 10			„ 40			
		1 man in part			„ 5			
		1 „ „			„ 2			
		2 women „			„ 2			
		10			—	79	0	0
	6	Bonus for one-year agreement from 8th June to one man				15	0	0
Commission ...	7	Rewards, at Rs. 2 a head to outsiders for inducing the above 25 labourers to settle down and sign agreements				50	0	0
		Total				330	5	0

IV. Supervision and Miscellaneous.

Supervision ...	1	Sardár's pay for March				10	0	0
	2	Babu for April, May, June, July, and part August, at Rs. 20				92	8	0
	3	Jemadár on Rs. 10 for April, May, part June ...				24	0	0
Miscellaneous ...	4	For seed cocoons				4	0	0
	5	Small boat for carriage of leaf				16	0	0
	6	Roads and bridges				11	11	9
	7	Stationery				6	14	9
	8	*Batta* for pice				0	6	3
	9	Cost of recovering bonus—						
					Rs. a. p.			
		Vakíl's retainer			5 0 0			
		Petition			2 0 9			
		Warrant fees			4 0 3			
		Clerk for writing petition			1 0 0			
		Cost of withdrawing agreement papers from court			0 9 3			
						12	10	3
	10	Food for messengers				1	11	6
		Total				179	14	6

V. Rearing.

Feeding ...	1	Feeding worms, cleaning trays, &c., in April ...				10	15	0
	2	Ditto ditto ditto May and June				61	4	9
	3	Ditto ditto ditto July ...				83	11	3
		Total				155	15	0

ABSTRACT.

I.	Buildings and fittings	...	...	...	...	1,038	9	0
II.	Cultivation of area	...	...	...	...	686	9	6
III.	Procuring labour	...	...	...	...	330	5	0
IV.	Supervision and miscellaneous		...	...	...	179	14	6
V.	Rearing ...	...	...	...	...	155	15	0
	Grand total ...	...	...	...	...	2,391	5	0

APPENDIX H.

FURTHER DETAILS AS TO THE EXPERIMENT IN CACHAR.

(*a*) *Buildings.*

1. All rough buildings in Sylhet and Cachar are paid for at so much per *háth* of 1 foot 6 inches in length. The rate varies with the width of the building, but the price is always obtained by multiplying the rate by the number of *háths* in the length.

2. All buildings are raised on a mud plinth, with wooden posts, roofs of sun-grass thatch, and reed walls plastered with mud.

3. The six feeding-houses mentioned contained each four *machán*s, or frames. Each *machán* held twelve trays one over another, each tray being 4½ feet wide and 35 feet long. There was a space of 3 feet all round each tray, so that the dimensions of the houses came exactly to 18′ × 79′, or 12 *háths* by 53 *háths*. Therefore, the six houses contained 228 trays.

(*b*) *Labour.*

1. Bonuses had to be given to induce the labourers to enter into agreements to work for a year. They were all Bengalis obtained from the surrounding villages. Besides the bonus, they were to receive 4 annas for a full task.

2. The regular rate of pay was 4 annas for a day's work hoeing. In flat land the day's work was 25 *nulls* and in sloping land 40 *nulls* (1 *null* = 144 sq. ft.); the rate varied with the nature of the ground. If a man then chose to do more than a day's work, he was paid accordingly, and earned more than a day's pay.

3. The staking consisted in marking out the area with stakes or slips or bamboos 2 feet long at intervals of 4′ × 4′. This was paid for at Re. 1 per 1,000 stakes. The sowing consisted of digging a round hole at each stake, one foot in diameter and one foot deep, and filling in the earth again after putting a few seeds down. This was paid for at 200 holes for 4 annas, and in a few instances at a slightly higher rate.

(*c*) *Miscellaneous.*

Patna castor-seed cost in Calcutta Rs. 4 a maund. Packing in bags and carriage to Kallinecherra added about Re. 1 to the price. Local seed was obtainable in the district at Rs. 4 a maund, the carriage varying from 2 annas to Re. 1 a maund according to distance.

APPENDIX I.

The Castor-oil Crop.

The castor-plant can be grown on almost any kind of soil, although it thrives best on a sandy loam and will not flourish well on clay. Newly-cleared forest lands suit the crop particularly well. In Upper India it is generally cultivated with other crops, but sometimes also alone. It is used sometimes as a hedge round the field, affording protection from high winds to the smaller crops inside the field. The seed is generally sown twice in the year—

(1) In March or April, two or three months before the rains, when it is sown generally along with sugarcane.

(2) In July, at the beginning of the rainy season, along with other rain crops.

The seed, after being soaked in water for twelve hours, is generally sown with the hand one yard apart. If sown alone, about 12 lbs. of seed are required for one acre of land. The crop needs no further care generally, except watering if the land is too dry, and weeding if it is too wet.

As a general rule, however, the seed is put down at the beginning of the rains, or just before the monsoon breaks. The seeds are sometimes sown behind the plough, being dropped at intervals of about 18 inches into every alternate furrow, or else they are planted by hand. In the latter case a little manure is generally buried with them. The young plants are occasionally earthed up to prevent the accumulation of water round the bottom of the stem.

The fruit of the first sowing begins to ripen in November, and continues to yield seed till March. The fruit of the second sowing ripens about May. The plants are generally cut down after having borne for one year, as the second year's produce becomes inferior in quality as well as in quantity. A well-grown castor plant will yield as much as 10 seers of seed in a season, but the plants which are grown round fields rarely give more than from ¼ seer to 1½ seer apiece. The yield of individual plants grown together as a single crop in a field is much less than this, since flowering is hindered by loss of light and air, when the plants are not separated from each other by a considerable space.*

* *Note.*—Most of the above information has been extracted from "Field and Garden Crops of the North-Western Provinces and Oudh."

BRASS AND COPPER WARES IN ASSAM.

By E. A. GAIT, Esq., *I.C.S.*, 1894.

Introductory.

One of the provincial peculiarities disclosed by the caste tables prepared in connection with the last census was the almost entire absence in the Assam Valley of the lower professional castes which are found in almost all other parts of India. This fact explains why, as has so frequently been pointed out, that portion of the province possesses no local industries of interest or importance.

It is true that in the time of native rulers some industries were fostered, and we read that the Ahom king Chu Chengpha (also known as the Burhá Raja or Pratáp Singh), who reigned from 1611 to 1648 A.D., introduced goldsmiths, blacksmiths, and other artizans from Koch Bihár, and tried to induce his subjects to follow similar occupations. Some of them did so; a section of the Kacháris took to gold-washing and became known as Sonowál Kacháris; members of the Koch, Kalita and other agricultural castes became, some of them potters, others blacksmiths, and others workers in brass and bell metal; and according to the occupation adopted, the words Kumár, Kámár, and Káshár were prefixed to their proper caste names. But the time which elapsed between the date when they began to take up these trades and the occupation of the country by the British was too short to allow of the development of any special skill, or the origination of any manufactures possessing peculiar local characteristics. When Assam became British territory, none of the occupational sub-castes, which had begun to form, had developed sufficiently to have drifted apart from the main body of the castes to which they belonged; intermarriage was still permitted between them and their caste-fellows, and there was nothing to prevent them from following agriculture as a means of livelihood, any more than there was to prevent other members of these castes from becoming potters or blacksmiths or workers in brass or bell metal. As soon as the advent of the British opened up the province to external trade, the effects of this absence of special skill and of the want of fixity of occupation which caste scruples impose elsewhere, soon became apparent. Cheaper and better articles of foreign manufacture began to oust the local products, and most of the persons engaged in making the latter, when they found that their trade was becoming unprofitable,

abandoned it, and turned their attention to agriculture. With very few exceptions, the articles which are still manufactured in the Assam Valley consist of the cheap utensils in common daily use, the making of which requires no special skill, and on which the cost of freight places imported wares at a great disadvantage as compared with those made locally.*

In the Surma Valley also, although there are more persons belonging to the professional castes of the Nava Sákha group, it would seem that agriculture is generally preferred by them as a more honourable means of livelihood, and that the comparatively small numbers who still follow their traditional occupations are unable to compete successfully with foreign manufacturers, except in regard to the cheap and common articles above referred to.

The native state of Manipur is the only place in the province where articles of ornament as well as use are made, and even there there is very little that deserves special mention.

Extent to which brass and copper wares are made locally.

2. So far as the character of the articles made is concerned, the above general observations apply in their entirety to the local manufacture of brass and copper wares. With the exception of Manipur, copper wares are made nowhere in the province,† while brass and bell metal are only worked up into the common pots and pans in daily use amongst the people. But even of these common utensils the local supply is insufficient, and large quantities are annually imported from Bengal. No district in Assam is specially noted for its manufactures of this description.‡

Castes engaged in manufacture.

(a) Assam Valley.

3. The general considerations mentioned in the introductory paragraph of this note apply also to the caste of the persons engaged in manufacturing articles of copper and bell metal in the Assam Valley districts. They are, for the most part,

* As will be seen further on, the raw material is imported, but it is obviously far cheaper to transmit solid blocks or sheets than manufactured pots and pans. The latter are, moreover, liable to damage in transit.

† In Kámrúp, goldsmiths are said to manufacture copper articles on indent. But the total amount of work thus done is insignificant.

‡ The following figures, showing the imports in maunds of wrought and unwrought brass and copper, which are extracted from the River-borne Trade Report for 1892-93, show how petty the local manufactures are :

	Copper.		Brass.	
	Wrought.	Unwrought.	Wrought.	Unwrought.
Brahmaputra Valley	540	10	3,515	2,735
Surma Valley	159	20	8,594	165
Total	699	30	12,109	2,900

Figures for bell metal are not available, as this article is not shown separately in the statistics appended to the report in question.

persons of the Kalita, Koch, and Kewat castes, the word Káshár being tacked on to their proper caste name as an indication of the occupation which they follow. There is, however, no real distinction between Kalitas, Koches, and Kewats, who are Káshárs, and other persons belonging to these castes, except that the agricultural community look down on all persons following mechanical pursuits, and describe them as "Saru" or "small," while they call themselves "Bar" or "great."

The manufacture of brass utensils, on the other hand, enjoys the distinction of being the only industry of the sort which is appropriated by a particular caste. It is the traditional occupation of the Morias, who have a very peculiar history. The *Assam buranjis* (historical narratives) state that they are the descendants of prisoners captured by the Ahoms during Turbuk's unsuccessful invasion of their territory about 1506 A.D. These prisoners, it is said, were at first employed as grass-cutters for the State elephants, but proved so useless that they were soon employed instead as cultivators, but at this work also they proved utterly useless. They were then left to their own devices, with the result that they adopted brass-working as a means of earning a living, and on this occupation they are still exclusively employed. Cases in which Morias have taken to agriculture are very rare.

Owing to their isolation, the Morias gradually fell away from the observances enjoined by their religion, and a few years ago it was stated regarding them that they ate pork and drank spirits, and have given up the practice of circumcision. Of late, however, the Mullahs have been at work among them, and they are now rapidly assimilating their practices and habits of life to those of ordinary Musalmans.

The origin of their name is not certain; it may be a corruption of *mariya* (beating), a name applied with reference to their use of the hammer for making their wares, or it may be a jingling corruption of Goria, a term assumed by the ordinary Musalmans of this province as an assertion of their claim to have come originally from Gaur.

The necessity for living near their market has led the Morias to migrate a good deal, and within the last few years one colony has left Sibságar and settled in Mangaldai, and another has gone from Jorhát to Silghát in the Nowgong district.

They are a very industrious people, working often till a late hour of the night, and, unlike other artizans in this province (with the single exception of the Hiras), they are aided in their work by their women.

(b) Surma Valley.

I have no special information regarding the persons employed on this work in Sylhet and Cachar, beyond that they belong to the Kánsári caste, and differ in no important respect from the members of this caste in Bengal. Their homes are mostly in the Hábiganj and South Sylhet subdivisions, and in pargana Panchakanda in the Karimganj subdivision, but the chief places where they ply their trade are Sylhet town and Nijpát Jaintiápur.

(c) Manipur.

In Manipur, copper is worked by the Kaisám, Kángbám, and Tourángbám sections of the people; bell metal by the Ahaibám and Senjám; and brass by all the above, but principally by those mentioned as working in copper, who are also very often goldsmiths.

Method of manufacture.

(a) Assam Valley.

4. In the days of the Ahom kings, it is said that bell metal was made locally, but this is no longer the case, and even when it was done, the product is said to have been inferior to that obtainable from Bengal. The raw material is now either imported from Bengal or obtained by the purchase of broken or unserviceable articles made of this alloy. Bell metal utensils are manufactured by casting in moulds. They are generally made to order, and are not usually manufactured in large quantities for sale to possible customers. The chief centres of manufacture are Sarthaibári in the Barpeta and Titábar in the Jorhát subdivision. As has already been stated, the local supply is not sufficient to meet local requirements, and importations from Bengal are considerable.

The Morias, on the other hand, never resort to casting, but make their utensils from thin sheets of brass, which they hammer out and piece together so as to obtain the desired shape. These sheets, which are imported from Europe, are purchased by them from Márwári merchants, who often sell them on credit, on the understanding that the manufactured utensils will be sold to them at a somewhat reduced rate. The following description of the instruments used by them and the way in which they are applied, is reproduced from a note written by Mr. Darrah in 1885:

1. *Belmuri* (*large anvil*).—This is a block of iron, shaped like a short, thick, flat-topped tent-peg. The diameter of the top is about one-third the whole length. The pointed extremity is driven through a hole in a small board and into the ground below. The board keeps the anvil from being driven too far into the ground by the hammering it receives during work.

2. *Chátuli* (*small anvil*).—This is a bar of iron, shaped exactly like a tent-peg, with a flattish head. The pointed end is driven into the ground and the article to be manufactured beaten into shape on the top.

3. *Dhekâ* (*double anvil*).—This is shaped like the head of a hammer' except that it is thinner, longer, and has one end pointed. The part which in a hammer is prolonged over the wood of the handle consists in the *dhekâ* of a point, which is driven into the ground, or a piece of wood when the implement is being used.

4. *Harugarâ* (*hammer*).—It is medium-sized, with one straight and round, one curved and chisel-shaped extremity. The handle passes through a hole in the head.

5. *Pâtmarâ* (*hammer*).—Shaped like a pick-axe, but with chisel-shaped ends.

6. *Barhâturi* (*large hammer*).—Shaped like the *harugarâ*, but very much larger and heavier. The flat extremity is hexagonal in shape. It is only employed in heavy work.

7. *Gulmarâ* (*hammer*).—The head is very long and thin, but the general shape is the same as that of the *harugarâ*. It is used for hammering the interior of utensils into which ordinary hammers cannot go.

8. *Mâlhani*.—A small thick-set hammer, with one end shorter than the other.

9. *Sarâh* (*pincers*).—There are two kinds, one like an ordinary pair of English blacksmith's pincers, and one like a pair of sugar-tongs.

10. *Kâti* (*scissors*).—Roughly made, and with blunt points, but strong enough to cut sheet brass.

11. *Bhâti* (*bellows*).—These are made of goat's skin, with the hair outside. They are funnel-shaped, and the point of the funnel is connected by means of a small bamboo pipe with a narrow underground channel communicating with the bottom of the furnace. The upper part terminates in a wide mouth, formed by two slips of bamboo about a foot long. A loop of string attached to the centre of each connects the two slips of bamboo. The operator works the bellows with his left hand, adjusting the fire with a rod held in his right. The loop passes over his hand, and as he raises it with the slips of bamboo apart, air fills the bellows; the hand is then closed, thereby bringing the two slips together, and pressed down, thereby forcing the air into the furnace.

12. *Aphuri* (*furnace*).—This is simply a hollow in the floor of the hut.

13. *Bâgi* (*chisels*).—These are small instruments with the extremities slightly bent, and used for cutting rings and other ornamental devices on the finished brass utensils.

14. *Mâhi* (*crucible*).—A small gourd-shaped vessel of baked clay, about 4 inches in diameter. When in use, the mouth is covered by a little cake of clay called *maula*.

15. *Pajâl* (*mould*).—This is a piece of baked clay, exactly like a brick, with hollows of various shapes on the surface.

16. *Ndorâ* (*a wooden trough containing water*).—It usually stands close to the *âphuri*.

17. *O* (*file*).—Triangular and square ones are in use. The latter are made by the Morias themselves, and are very rough.

18. *Nagarâ*.—A ring made of grass and used in breaking up *pân* as described below.

19. *Kundha.*—This is a species of lathe, consisting of a rod of wood inserted at one end into one of the posts of the house and at the other into a peg (*barisilá*) driven into the ground. Articles which are ornamented by rings cut into the brass are fixed on the rod with lac and turned.

Pán is the material used in joining the sheet brass where a junction is necessary. It is made by melting together three parts of sheet brass and one part of solder (*setu*). The result is a brittle compound, which is broken up into fragments on an anvil, inside the *nagará*. The *pán* will not flatten out when struck by a hammer, it breaks up. In melting the *pán* the crucible is more than once taken out of the fire, and rolled in a heap of rice husks (*tuh*). This is said to remove all danger of the clay-breaking. Goat's fat is put into the mould before the melted *pán* is poured into it. When it becomes necessary to join the two edges of a sheet of brass, nicks are cut in one edge and the other edge fitted into these, and the two beaten flat. Then a rough paste is made of some broken up *pán* and borax (*soyágá*), which is smeared over the joining. The junction is then heated. The *pán* melts, and the union is cemented.

(*b*) Surma Valley.

In the Surma Valley, as in the Assam Valley, brass utensils are invariably made by hammering out thin sheets of the metal, which are imported from Calcutta, either by the braziers themselves or through *áratdárs* (commission agents). Bell metal utensils are cast.

(*c*) Manipur.

In Manipur also, the usual manner of working brass is that described above. The two clans (Ahaibám and Senjám) who work chiefly in bell metal are reported also to cast brass, but they do very little work in this metal. The raw material, of course, is imported.

The manner of making bell metal utensils, which are manufactured by the two clans just mentioned, is described by the Political Agent as follows:

A solid mould of clay and rice husks, after being turned to the required shape with a lathe, is burnt. It is then coated with wax, which, being well smoothed and daubed over with a mixture of reed ash and earth, is itself coated over with a layer of clay and *bhusi*. This is dried, but not burned in the fire, and after the wax has been melted out by the application of heat, the molten bell metal is poured into the now empty space which the wax occupied. The vessel after cooling is extracted from the earthen mould, and is turned in a lathe and polished.

The material, presumably, is imported, and so also is the copper, which is worked by the Kaisám, Kángbám, and Taurángbám sections. An attempt was made by one of the Maharájas to work the copper which is found in the hills on the east of the State near Tammu, but the metal produced was of inferior quality, and the idea was consequently abandoned.

5. The following is a list (not very complete) of the different utensils manufactured from brass, copper, and bell metal :

Articles manufactured.

Metal.	Name of article.	Description.	Price.	Remarks.
1	2	3	4	5
		(a) Brahmaputra Valley.		
Brass ...	Berhá ...	A tripod consisting of a ring about a foot in diameter, supported on three hollow cone-shaped legs, the interior of which is filled with pieces of broken brass, which produce a jingling sound. The tripod stands about 14 inches high, and is used to support the flat dish out of which an Assamese of the better class eats his rice.	Rs. 7 to Rs. 10.	
	Chákí ...	A lamp, or rather brass stand, with an open cup-shaped vessel at the top, which is used for holding oil. The wicks are simply threads of cotton laid across the ends, projecting beyond the edges of the cup.	As. 6 „ Re. 1.	
	Chariyá...	Used as a wash-hand basin, and sometimes also as a receptacle for sundry articles.	Re. 1-8 „ Rs. 3.	The same as the *tágár* of the Surma Valley. Also made of bell metal.
	Don ...	A measure holding five seers.	„ 1-8 „ „ 2	
	Ghágari ..	A decanter-shaped vessel with an ornamented top, formed of 8 pieces of brass and used for keeping and carrying water in.	Rs. 2-8 „ „ 5.	
	Ghatí ...	A small jug	Re. 1 „ „ 3.	
	Gochhá...	A lamp stand	„ 1 „ „ 2.	
	Kalah or Kalsi.	This is exactly like the *ghágri*, except that it is provided with a brass rim round the bottom to enable it to be placed upright on the ground. The top is sometimes ornamented and sometimes plain.	Rs. 2 „ „ 3	Also made of bell metal and copper. Those of copper are used for holding water for religious ceremonies. The same as the *kalsi* of the Surma Valley and the *tukna* of Manipur.
	Kariá ...	Milking pot	Re. 1-8 „ „ 2.	

Metal.	Name of article.	Description.	Price.	Remarks.
1	2	3	4	5
		(*a*) *Brahmaputra Valley*—continued.		
Brass ...	Kharáhi	A sieve used for rinsing rice...	Re. 1 to Rs. 3	The same as the *jhánjri* of the Surma Valley.
	Khundáná	Something like an elongated thimble, used by old people for pounding *pán* and betel-nut so as to facilitate mastication.	As. 8 to Re. 1.	
	Lotá ...	A sort of small jug used for holding water, and also as a drinking vessel.	Re. 1 to Rs. 4	The same as the *lotá* of the Surma Valley and the *khujái* of Manipur. Also made of bell metal.
	Sarái ...	A round tray used by Hindus for carrying rice, pulse, fruit, and other articles when making religious offerings.	Rs. 5 „ „ 15	Also made of copper.
	Setá ...	A large spoon with a handle, thin towards the bowl and thick towards the opposite extremity, used in distributing rice and curry.	As. 8 „ Re. 1	The same as the *hátá* of the Surma Valley.
	Temá ...	A small round box in which areca nuts are kept.	„ 8 „ „ 1	The same as the *dibi* of the Surma Valley. Also made of bell metal.
	Temi ..	A box (smaller than the *tema*) in which the lime eaten with the betel is kept.	„ 4 „ As. 8	The same as the *chunáti* of the Surma Valley. Also made of bell metal.
	Tháli or jháká.	A large boiling vessel ...	Rs. 5 „ Rs. 20.	
	Tou ...	A basin-shaped vessel generally used for cooking food and boiling paddy, and sometimes also for keeping various things, such as water, paddy, &c.	Re. 1 „ „ 5	The same as the *tasla* of the Surma Valley.
Bell metal.	Bánbáti...	A cup joined to a circular rim at the bottom (2″ to 3″ in height) for holding curry. The interior of the rim is filled with pieces of brass, which produce a jingling sound.	Rs. 2 „ „ 5.	
	Bánthál ..	A concave-shaped round dish, joined to a circular rim at the bottom (about 4″ to 5″ in height) for holding rice. The interior of the rim is filled with pieces of brass, which produce a jingling sound.	„ 6 „ „ 10.	

Metal.	Name of article.	Description.	Price.	Remarks.
1	2	3	4	5
		(*a*) *Brahmaputra Valley*—concluded.		
Bell metal.	Barkáh ...	A gong	Rs. 4 to Rs. 15.	
	Báti ...	A cup for holding curry, &c., without a rim at the bottom.	„ 2 „ „ 5	The same as the *báti* of the Surma Valley and the *tengkot* of Manipur. Also made of copper.
	Botá ...	A flat circular basin with raised edge (generally ornamented) joined to a circular rim at the bottom (3″ to 6″ in height) for holding betel-nuts.	„ 3 „ „ 7	
	Dogdogi .	Similar to a *lotá*	„ 5 „ „ 8.	
	Káhi ...	A flat circular basin with a raised edge for holding rice.	„ 2 „ „ 7.	The same as the *thál* of the Surma Valley and the *pukám* of Manipur.
	Maipong .	The same as the *bánthál*, with the addition of a cover. This was used by the Ahom Rájas and chiefs. It is no longer manufactured unless specially indented for.	„ 10 „ „ 20.	
	Pandhoá .	A flat basin with ornamented raised edge (higher than that of a *thal*) for holding rice.	„ 3 „ „ 5.	
	Píkdán ...	A spittoon ; the same shape as, but larger than, a *temi*.	„ 3 „ „ 4	The same as the *kwásen* of Manipur.
	Tál ...	Cymbals	„ 3 „ „ 20	The same as the *karatál* of the Surma Valley and the *kárdan* of Manipur.
		(*b*) *Surma Valley*.		
Brass ...	Bátá ...	A shallow pan used for holding betel leaf, areca nuts, and other ingredients used with them.	As. 12 to Re. 1-8.	
	Dábar ...	A wash-hand basin ...	Rs. 2 to Rs. 4.	
	Deg ...	Used for cooking rice, boiling water, &c.	„ 4 „ „ 10	The same as the *deg* of Manipur.
	Hátá ...	A large spoon with a handle, thin towards the bowl and thick towards the opposite extremity, used in distributing rice and curry.	As. 8 to Re. 1	The same as the *seta* of the Assam Valley.
	Jhánjri ...	A sort of sieve for cleansing rice in water before boiling it.	Rs. 2 „ Rs. 4	The same as the *kharahi* of the Assam Valley.

Metal.	Name of article.	Description.	Price.	Remarks.
1	2	3	4	5
		Surma Valley—continued.		
Brass ...	Kalsi ...	A large jug for carrying water.	Rs. 2-8 to Rs. 5	The same as the *kalah* of the Assam Valley and the *tukná* of Manipur.
	Lotá ...	A sort of small jug used for holding water, and also as a drinking glass.	Re. 1 „ „ 4	The same as the *lotá* of the Assam Valley and the *kujái of* Manipur.
	Modhárá .	A pot with a narrow neck used as a still by the inhabitants of the Khási and Jaintia Hills.	Rs. 4 „ „ 6	Exported from Sylhet to the Khási and Jaintia Hills.
	Tágár ...	A sort of wash-hand basin made of different sizes, sometimes used in distributing rice and curry.	Re. 1-8 „ „ 3	The same as the *chariya* of the Assam Valley.
	Taslá ...	A basin-shaped vessel, smaller than the *deg*, used for cooking food, boiling water, &c.	„ 1-8 „ „ 4	The same as the *tou* of the Assam Valley.
	Thál ..	A dish for holding rice and curry.	„ 1 „ „ 2	The same as the *pukam* of Manipur and the *káhi* of the Assam Valley.
Bell metal.	Páti ...	A cup	As. 6 „ „ 2	The same as the *tengkot* of Manipur and the *bati* of the Assam Valley. Also made of brass.
	Bátlai ...	A vessel for cooking rice, used especially by the Hindu widows of the better class.	Re. 1 „ „ 3.	
	Chunáti .	A small round pot with a cover in which the lime eaten with the betel is kept.	As. 6 ...	The same as the *temi* of the Assam Valley. Exported to the Khási and Jaintia Hills.
	Dibi ...	A small round pot (larger than the *chunati*) with a cover, in which prepared betel is kept.	„ 4 to Re. 1	The same as the *temá* of the Assam Valley.
	Hukárkhol	Used for mounting cocoanut *hukás.*	Re. 1 „ Rs. 2.	
	Karatál...	Flat round plates (cymbals) with a hole in the centre through which a string is passed. Used at *sankirtans* (hymn songs) as a musical instrument.	„ 1 „ Re. 1-8	The same as the *kardán* of Manipur and *tál* of the Assam Valley.

Metal.	Name of article.	Description.	Price.	Remarks.
1	2	3	4	5
		(c) *Manipur.*		
Brass ...	Deg ...	Used for cooking rice, boiling water, &c.	Rs. 5 to Rs. 10	The same as the *deg* of the Surma Valley.
Brass ...	Khujái ...	A small jug used for holding water, and also as a drinking glass.	Re. 1 „ „ 4	The same as the *lotá* of the Surma and the Assam Valleys. Also made of bell metal.
	Korphu...	A cooking pot ...	Rs. 2 „ „ 3	Also made of bell metal.
	Pukám ...	A dish	Re. 1 „ „ 2	The same as the *thál* of the Surma Valley and the *káhi* of the Assam Valley.
	Tengkot..	A small cup	As. 4 „ Re. 1	The same as the *báti* of the Surma and the Assam Valleys. Also made of bell metal.
	Tukná ...	A large jug for carrying water	Rs. 2 „ Rs. 5	The same as the *kalsi* of the Surma Valley and the *kalah* of the Assam Valley.
Bell metal.	Kardán...	Cymbals	Re. 1 „ „ 2	The same as the *karatál* of the Surma Valley and *tál* of the Assam Valley.
	Kudái Sel.	An ewer	„ 1 „ „ 3	
	Kwásen ..	A spittoon	„ 1 ...	The same as the *pickdán* of the Assam Valley.
	Senká ...	A *pán*-holder	Rs. 2 to Rs. 5	
Copper..	Kushi ...	A sort of spoon to hold water at *pujás*.	As. 4.	
	Tami ...	A cup for holding water at *pujás*.	„ 8 „ Re. 1-8.	

Profits of the business.

6. The information available regarding the profits of the business are very meagre. Workers in bell-metal are said to be able to turn out from one to one and a half maunds of utensils monthly, the wholesale selling price of which varies from Rs. 65 to Rs. 130 per maund, and the retail from Re. 1-12 to Rs. 3-8 a seer. Their income is estimated at from Rs. 30 to Rs. 80, but this seems excessive.

The cost of the brass sheets used by the Morias in Dibrugarh is said to be 14 annas per seer, and the retail price of the manufactured articles from Re. 1 to Re. 1-1 per seer, if sold to Márwáris, and Re. 1-2 if sold to the public. According to another estimate, the Morias buy their brass at Rs. 30 to Rs. 40 a maund, and sell their manufactured articles at Re. 1-8 a seer, or Rs. 60 a maund. It is said that they can manufacture on the average two maunds weight of utensils a month. Consequently, the smallest estimated monthly profit is Rs. 16 and the highest Rs. 60. The real income probably approximates more nearly to the former than to the latter figure. There is a certain amount of expenditure on implements and charcoal, especially the latter, except in jungly places, where the braziers make their own.

Conclusion.

7. The above note is very brief, and is in many respects incomplete. If more time had been allowed, it could have been added to in some ways, but in view of the very petty character of the industries dealt with, it is doubtful whether a more detailed enquiry would be worth the trouble which it would involve.

POTTERY IN ASSAM.*

By E. A. GAIT, Esq., *I.C.S.*, 1895.

In my note on the Manufacture of Brass and Copper Wares in Assam, I pointed out the almost entire absence in the Brahmaputra Valley of the lower professional castes which are found in other parts of India.†

Castes engaged in the manufacture.

(*a*) Brahmaputra Valley.

In the later days of Ahom rule, artizans were introduced from outside, and efforts were made to induce the people to learn different handicrafts. Some of them did so, especially people of the Kalita, Kewat, and Koch castes, and the occupations thus adopted were gradually becoming hereditary, and functional endogamous sub-castes were slowly being developed, when the annexation of the country put a stop to the process.

Thus, not only are there no regular professional castes engaged in the manufacture of pottery, brassware, &c., but the sub-castes who follow these occupations do not look on them as their only source of livelihood, and follow the ordinary agricultural avocations of the people, as well as the special handicraft which they have inherited from their ancestors.

There are two distinct classes of persons engaged in the manufacture of pottery in the Brahmaputra Valley, the Hirás and the Kumárs.‡ The former were originally Chandáls, and, of all the functional sub-castes, they approach most nearly to the position of a separate caste. There is, however, no doubt of their close connection with the Chandáls: they still intermarry with them; they eat food cooked by them; they have the same *Patit* or *Barna* Brahmans as their *Purohits*, and they have no scruples in the matter of selling fish themselves.

The word "Kumár," on the other hand, so far as the Brahmaputra Valley proper is concerned,§ is not used to denote persons of any particular caste or sub-caste, but is applied to persons of

* The subject prescribed for this year's monograph is pottery and glassware, but there is no manufacture of glassware in this province. I do not refer in this note to the pottery made by the Assam Trading Company, because their business is still small and their methods are European rather than Native.

† For a possible explanation of this circumstance, see the article on Kalitas in the last Provincial Census Report (page 210).

‡ The word "Kumár" is derived from "Kumbhakár," and means "maker of pots."

§ In Goálpára the Kumárs form a distinct caste, as in the Surma Valley.

several different castes (chiefly the Kalita, Kewat, and Koch) who make, or whose ancestors are remembered to have made, articles of earthenware. Thus, there are Kumár Kalitas, Kumár Kewats, and Kumár Koches, and the people so designated continue to retain their old caste status.

Within the caste, they rank equally with persons belonging to other functional subdivisions (*e.g.*, the Kámárs and Káshárs), but below those members of the caste whose occupation is said to have always been purely agricultural; the distinction, however, is by no means well marked amongst the Kewats and Koches, and is not a very firm one, even amongst the Kalitas in the western portion of the valley. A well-to-do Kumár Kalita of Kámrúp or Mangaldai would have very little difficulty in obtaining a Bar Kalita bride, and his descendants would probably, in course of time, succeed in obtaining recognition as the equals of Kalitas who had never followed other than purely agricultural pursuits. Higher up the valley, it is said to be much more difficult for a Kumár Kalita to raise himself to the status of a Bar Kalita.

In a few rare instances, persons other than Hirás and Kumárs are found manufacturing earthen vessels in the Brahmaputra Valley. In the Tezpur subdivision a few Doms make large earthen pots, which are used for boiling *gur*; they rank equally with other Doms, and only make these utensils as a secondary occupation, their main means of livelihood being the catching and selling of fish. Near Dibrugarh, some few families of up-country men from Arrah are potters by profession. They are known locally as Hirá Kumárs. Some up-country potters have settled recently at Golághát.

(*b*) Surma Valley.

2. In Sylhet and Cachar, the word "Kumár" denotes, what it does in Bengal, the separate potter caste, *i.e.*, one of the nine professional castes (Navasakha), which are said, according to the commonly-accepted Hindu tradition, to be descended from the offspring of Visvakarma, the divine artizan, by a Sudra woman. Members of the caste rank as Sudras, and Brahmans will take water from their hands and serve them as their priests. The Kumárs sometimes call themselves Rudrapal, in vindication of their claim to be descended from the beads of Mahadeva (*Rudrákshа*). Some members of the caste go still further, and, dropping the Rudra, say that their proper appellation is Pál, or Káyastha.

Besides the Kumárs, there are in Sylhet some Mussalman potters, locally known as Khuskis, who prepare the plates called *sának* for their co-religionists. The Khuskis are said to be endogamous; they are looked down on by ordinary Mussalmans, just as are the Máhimals or Muhammadan fishermen.

3. In the Gáro Hills, pottery is made by persons of the same caste as the Kumárs of Sylhet; in the Khási and Jaintia and the Nága Hills districts, the caste system is unknown, and there the business is carried on by any one choosing to learn the work.

(c) Hill districts and Manipur.

* In Manipur, the persons engaged in the manufacture of pottery are known as Luis, who are said to be the descendants of Kabui Nágas. Their status is below that of ordinary Manipuris, but there is no perceptible difference in their habits or manner of life.

4. The articles manufactured in this province are not of any special interest, and consist chiefly of the rough utensils in common daily use amongst the people.

Articles manufactured.

A list of the more important articles made is given in the Appendix.

5. The earth used is generally a glutinous clay (*áthá máti* or *álatiyá máti*), but information on this point is not very precise or satisfactory. That used by the Kumárs of the Brahmaputra Valley is of a dark blue colour, and is known as *kumár máti*; it is procurable without much difficulty in most parts of the country,—usually on the banks of streams. The Hirás use a peculiar kind of clay, which is more rare, and it is reported that in the whole of the Kámrúp district there are only two places (Molung and Agiathuli) from which it can be obtained. This clay, which is called *hirá máti*, is of a gray colour, and is very stiff; owing to this fact, it makes better earthenware than the *kumár máti*, but the Kumárs do not use it, as it is not easily worked into shape on the wheel.* The up-country potters of Dibrugarh are said to get their earth from ant-hills (*háphalu*).

Earth used.

In the Surma Valley and the Gáro Hills, the earth used is generally known as *murha* or *atháli máti*, *i.e.*, a stiff clay, but for some utensils, which do not require any very great strength, a lighter kind of clay, called *káli máti*, is made use of.

The potters of the Jaintia Hills use two kinds of clay mixed,—one is of a dark-blue colour (*khyndew-iong*) and the other grayish (*khyndew-khluid*); these clays seem to correspond closely with the *kumár máti* and the *hirá máti* of the Brahmaputra Valley. The Nágas use a bluish black earth, called in Angámi Nága *khegsá*, which is probably the same as *kumár máti*. In Manipur, as in the Khási and Jaintia Hills, two kinds of clay are mixed. One of these is black, and is called by the Manipuris *leitál*, and the

* The Kumárs sometimes use it mixed with *kumár máti* for making well-rings, which are shaped, not on the potter's wheel, but on a form.

other is of a light red colour, and is known as *leicheng*, four parts of the former are used to one part of the latter.

Preparation of the earth for use.

6. The clay is in all cases first well moistened in water, and all extraneous substances are carefully removed. Where two different kinds of clay are combined they are mixed together very carefully. If the clay is of a very stiff nature, a certain amount of clean coarse sand is worked up with it.* In some cases, the pieces of old utensils powdered up, ashes, paddy husks, or some sort of fibre chopped up into small pieces, are mixed with the clay to add to the strength of the utensils made from it. In all cases the clay is thoroughly broken and worked up, the feet being largely used in the process.

Method of manufacture.

7. The Kumárs of both valleys use the potter's wheel for roughly shaping all the articles made by them, except well-rings and flat or saucer-like utensils. A moistened and well-kneaded lump of clay is placed on the inner disc of the wheel, which is fixed horizontally, and is made to rotate rapidly. As the wheel revolves, the workman moves the lump of clay about on the disc, and gives it the desired shape. The superfluous clay is then cut off with a string,† and the vessel is sun-dried for a time. When it has somewhat hardened, it is placed in a hollow mould made of wood or earthenware, which is sprinkled with sand to prevent the vessel from sticking to it, and is then made to assume its final shape by hand. The method adopted is to beat the exterior surface of the vessel with a flat wooden or earthenware mallet, held in the right hand, against a smooth, oval-shaped stone held by the left hand against the inner surface. When the required shape has been given to the vessel, it is again sun-dried, and the surface is then polished with a sort of earthenware pestle or (in Manipur) a piece of strong rag folded and moistened with water.

They are then sometimes coloured with red dust or cattle urine, after which they are ready for the kiln.‡ Flat articles made by Kumárs, such as plates, &c., and all utensils manufactured by the Hiras of the Brahmaputra Valley and the potters of the Khási and Jaintia and Nága Hills districts and Manipur, are roughly moulded on a flat disc of wood, and not on the wheel. The subsequent operations are the same as those already described. In the case of

* One object of adding the sand is said to be in order to prevent the articles made from cracking when being burnt in the kiln.

† From its supposed resemblance to a navel string, the Kumárs of the Brahmaputra Valley are nicknamed *Nári kátá Kumárs*.

‡ In the Khási and Jaintia Hills the colour is given by a decoction made from the wild date pine after the vessels have been taken out of the kiln, and while they are still hot.

articles with narrow necks made by the Hirás, the practice is to make them in successive layers, each layer being partially dried before the next is added.

It may be noted here that as sun is required for drying the articles before they are burnt in the kiln, the cold weather is the most favourable season for the work.

Implements used.

8. The following is a list of the rough implements used, with a description of each :

1. *The potter's wheel.*—Assamese *chák*, Bengali *chák.*—The diameter of the whole wheel is usually rather more than 3 feet. In the centre is a solid disc of tamarind or some other hard wood, some 13 inches in diameter, to which the outer rim is joined by four wooden spokes, each of which is about 6 inches in length. The outer rim, which is about 6 inches broad, is made of split bamboos, bound with cane and covered with a thick plaster of clay mixed with fibres of the sago palm (*chaur*) ; the object of this rim is to increase the weight of the wheel and thereby add to its momentum when in motion. An upright piece of *nagesvar* wood (*Mesua ferrea*) or *khair* (*Acacia catechu*), about 6 inches in length, supports the wheel ; it is fixed firmly in the ground and is pointed at the upper end, so as to enable the wheel to revolve on it freely ; a hollowed-out stone is let into the centre of the disc, where it rests on the point, so as to reduce the friction to a minimum. As already stated, the wheel is worked by hand, and revolves horizontally, the clay to be moulded being worked into shape on the disc as the wheel rotates. The earth under the wheel is generally scooped away, so that the upper surface of the wheel may be on a level with the ground on which the operator sits.

2. *The rolling board.*—Assamese *áphari*, Bengali *áthál*, Manipuri *kangoi.*—A flat board, or earthenware tray, on which utensils are roughly shaped when the wheel is not used.

3. *The mould.*—Assamese *athâli*, Bengali *athâii.*—A hollow sort of basin made of earthenware, about 16 inches long and 3½ inches deep, in which the final shape is given to all articles of earthenware, whether originally shaped on the wheel or on the rolling board.

4. *The mallet.*—Assamese *baliya piteni*, Bengali *baila*, Khasi *tyrnem*, Manipuri *khuyiajei*, Nága *jivû.*—From 6 to 12 inches in length, used for beating the clay into its final shape against a stone held on the other side. It is made either of wood, stone, or earthenware. This implement is sometimes also used when kneading the clay before working it into shape.

5. *The polisher.*—Assamese *cháki*, Bengali *cháki.*—Used for polishing the articles made, after they have attained their final shape and been partially dried.

6. *The kiln.*—Assamese *pághâli*, Bengali *pain.*—This is used by the Kumárs of the Surma Valley, and by some of those of the Brahmaputrá Valley. The Hirás and others burn their earthenware in the open. In both cases alike, the vessels are carefully stacked, with layers of straw between them, and firewood or cowdung as fuel underneath. In the Brahmaputra Valley a stack of utensils is called a *thupá.*

Division of labour.

9. The collection of the clay and firewood, the stacking of the utensils in the kiln, or *thupá*, and the rough shaping of utensils on the wheel, form the men's portion of the work. The final shaping and polishing of the utensils is always done by the women, and when the wheel is not used, as with the Hirás, the rough moulding is also done by them.

Profits of the business.

10. The general opinion of the officers consulted is that the profits of the business are very small, the average earnings being placed at from Rs. 4 to Rs. 6 a month. It is difficult to estimate the exact earnings, as no accounts are kept by the potters, and they generally prefer to barter their wares in exchange for rice or paddy, instead of selling them for a fixed price. There is, however, no doubt that the earnings are less than they were some years ago. Brass cooking utensils are cheaper than they were formerly, and the standard of comfort of the people is improving, so that brass vessels are in most parts supplanting those made of clay. In Sylhet, the better class of Musalmans are taking to china instead of earthenware, and throughout the province tin lamps and kerosine oil are taking the place of earthen *chákis* and mustard oil. Owing to these causes, the demand for earthenware articles is gradually falling off, while the trade is also depressed by the competition of foreign wares of a better quality, which are brought up in large quantities from Eastern Bengal, and more especially from the Dacca district. The decadence of the industry is not much to be regretted, as the articles made are of a very rough character and less durable than those imported from Bengal, and the people who make them in this province are not inclined to learn improved methods.

APPENDIX.

List of the more important Earthenware Articles manufactured in Assam.

Name of article.	Description.	Price.	Remarks.
	(*a*) *Brahmaputra Valley.*		
Adkalah ...	Small *kalah*	1 pice each	The same as the *hachi* of the Surma Valley.
Akasbáti ...	Lamps used at marriages and on other festive occasions, *e.g.*, at the Dewáli festival.	1 pice for 15 to 20.	
Akathia ...	Cooking pots, same as *dukathia*, but smaller in size ; used for cooking rice or curry.	3 pice each.	
Bánmalá ...	A *malá* (vessel) with a rim, in which curds, sugar, &c., are kept.	1 pice to 1 anna each.	
Bhuruki ...	Same as *máthia*, but smaller in size ; used for storing grain.	2 pice to 2 annas each.	
Chákali or Paticharu ...	These vessels are used for cooking curry. The difference between a *charu* and *chákali* is that the former is hollow, while the latter is less so, and flattened.	1 anna to 2 annas each.	
Cháki ...	An earthenware lamp, with an open mouth, on which the wick lies. Mustard oil is usually burnt in the *cháki*.	1 pice for 10 to 20.	The same as the *chatá* of the Surma Valley.
Charakdán ...	A hollow cylinder, about 20 inches high, used as a candlestick.	1 anna each	The same as the *bogná* or *pradiper gáchá* of the Surma Valley.
Chilim ...	These are of two kinds, *viz.*, *dhopátkhoá chilim* and *bhángkhoá chilim*. The one is used for smoking tobacco and the other for *ganja*. The two are slightly different in shape at the top. The *chilims* used for smoking tobacco are larger than those used for smoking *ganja*.	1 pice for 2	The same as the *kalki* of the Surma Valley.

Name of article.	Description.	Price.	Remarks.
	(*a*) *Brahmaputra Valley*—continued.		
Charu ...	Same as *tháli*, but of medium size; used for cooking rice. They are in use among the poorer classes who cannot afford to buy iron or brass utensils.	1 to 2 pice each.	
Damá or Dabá	Earthen rings, on which hides are fastened to make drums.	2 annas to 4 annas each.	
Daskathia ...	Used for cooking rice, and intended to hold food for three or four persons.	1 anna each.	
Gachá ...	A lamp-stand	2 pice each.	
Ghat ...	Water-pots used in *pujas* ...	4 annas to 2 rupees 8 annas each.	The same as the *ghat* of the Surma Valley.
Hándi or Hári	A wide-mouthed pot. It is largely used by Kacháris for cooking rice and brewing *mad*.	3 pice to 1 anna each.	The same as the *patil* of the Surma Valley.
Jangá ...	Somewhat similar in shape to the *hándi*, but longer. It is used by Kacháris for keeping water and *mad*.	4 to 5 rupees each.	
Juidhará ...	Fire-stove	4 to 5 pice each.	
Kalah ...	A decanter-shaped vessel, chiefly used for holding water. Also used for holding milk, *gur* (molasses), oil, &c. The capacity is from 4 to 5 gallons.	2 pice to 1 anna each.	The same as the *kalas* of the Surma Valley.
Khámpti Hária	Manufactured after a model given by the Khámptis for cooking their rice over steam. It is a drum-shaped pot, perforated at the base, and placed over another basin in which the water is boiled.	2 pice each.	

Name of article.	Description.	Price.	Remarks.
	(*a*) *Brahmaputra Valley*—continued.		
Kholá ...	Resembles in shape a *kalah*, with this distinction that it has a wider mouth and neck and is not quite so high. This vessel is generally used for cooking rice.	1 anna to 6 pice each, according to size.	
Malá ...	A small *charu* used in religious ceremonies.	1 pice each	The same as the *málsá* of the Surma Valley.
Malá Charu ...	Small trays for distributing eatables during festivals.	1 pice to 1 anna each.	
Máthia ...	A large oval-shaped pot, with a comparatively narrow mouth, used for storing grain, and sometimes as a box in which clothes are kept. When used for the latter purpose, the mouth is closed by a cover, which is pasted over it.	8 annas to 12 annas each.	
Mridanga or Khol.	Drums, larger than the *damá*, but made in the same way.	3 rupees to 4 rupees each.	
Nád pát ...	Well ring	6 annas to 12 annas each.	The same as the *pát* of the Surma Valley.
Nadia ...	A basin, something like a *chárn*, but has a rim, and is stronger; used for keeping sweetmeats in.	4 annas to 2 rupees each.	
Nágára ...	Small drums	12 annas each.	
Phuldán ...	Flower vase	1 rupee to 8 annas each.	
Piálá, Beria or Deg.	Is a shallow "*khola*," with a much wider mouth. The neck is shorter than that of a "*khola*." It is used for cooking purposes, as well as for keeping curds, salt, or molasses, &c.	1 anna each.	

Name of article.	Description.	Price.	Remarks.
	(*a*) *Brahmaputra Valley*—concluded.		
Sátar ...	Same as *daskhathia* and *akathia*, holding food for one person only.	2 pice each.	
Sarai ...	A kind of tray on which presents are offered.	1 rupee each.	
Tekeli or Bhetuá	The same shape as the *kalah*, but much smaller. Holds from two to four quarts.	2 for 1 pice.	
Tháli ...	Big pots for preparing molasses, and also used for storing up water and cooking food in feasts.	8 annas each.	
	(*b*) *Surma Valley and Gáro Hills.*		
Badká ...	A small jug used by Muhammadans instead of a *lotá.*	2 pice each.	
Bhetuá ...	Small earthen pot, used for cooking and other purposes.	4 for 1 pice.	
Bogná or pradiper gáchá.	Stand for *chátá*	1 pice each.	The same as the *charakdán* of the Assam Valley.
Chátá or mallikká.	Open lamp	12 for 1 pice.	The same as the *cháki* of the Assam Valley.
Chilim or kalki	Used for smoking purposes ...	5 for 1 pice.	The same as the *chilim* of the Assam Valley.
Dhákná ...	A kind of plate or cover ...	2 for 1 pice.	
Galás ...	A cup to drink out of ...	2 for 1 pice.	
Ghát ...	Small pot for holding water, also used in Hindu ceremonies.	1 pice each.	The same as the *ghát* of the Assam Valley.
Hachi ...	Small *kalas*	2 pice each	The same as the *ádkalah* of the Assam Valley.

Name of article.	Description.	Price.	Remarks.
	(*b*) *Surma Valley and Gáro Hills*—continued.		
Kalas ...	A large jug for carrying water.	2 pice each	The same as the *kalah* of the Assam Valley.
Káslá or Dema	Big earthen pot, used for cooking and other purposes.	2 pice each.	
Kási or Kái ...	A large plate	2 for 1 pice.	
Khádá ...	A kind of cup	1 pice each.	
Málsá ...	Ditto	2 for 1 pice	The same as the *máláh* of the Assam Valley.
Pát ...	Well ring	5 for 1 rupee.	The same as the *nad pát* of the Assam Valley.
Pátil ...	Small pot used for cooking and other purposes.	1 anna each.	The same as the *handi* of the Assam Valley.
Piála ...	Cup	2 for 1 pice.	
Sharáh ...	A kind of plate used as a cover.	4 for 1 pice.	
Sáṇak ...	A kind of plate used chiefly by Muhammadans to eat rice on.	3 for 1 pice.	
Sárai ...	A kind of jug for holding water	4 annas each.	
Tari ...	A small plate	10 for 1 pice.	

Name of article.	Description.	Price.	Remarks.
	(c) *Nága Hills.*		
Li ...	This is the same in shape as the *likuno*, but larger, and is used chiefly for cooking rice.	2 to 4 annas each.	
Likphu ...	This resembles a vase in shape, with a long contracted neck, terminating at the mouth in a fairly broad lip or flange. It is only used to carry water into the village. It ranges from 18 inches to 2 feet in height, and from 9 to 12 inches in diameter.	6 annas to 12 annas each.	
Liki ...	This is of the same shape as the *Likphu*, but larger. It is used only for the preparation of rice beer or "*z*."	12 annas to 1 rupee 8 annas each.	
Likuno ...	This is about the size and shape of the ordinary brass *lota*, but having proportionately a larger mouth. It is used for cooking vegetables, &c.	1 anna to 2 annas each.	
Setuli ...	A kind of earthen *korai*, used for roasting seeds, measuring from 10 to 20 inches in diameter.	4 annas to 8 annas each.	
Tatseli ...	This is of the same shape as *li*, only larger in size, some being as much as 18 inches in height and of about the same diameter.	6 annas to 12 annas each.	
	(d) *Khási and Jaintia Hills.*		
Khew-ranei ...	*Chatis* or *gharas*	2 pice to 4 annas each.	
Khew-syntiw...	Flower pots	2 annas to 4 annas each.	
Khew-um ...	*Gharas*	4 annas to 6 annas each.	

PRINTED AT THE ASSAM SECRETARIAT PRINTING OFFICE (GENERAL) No. 483—200—25-3-96.